THE Festivus

Vol. 52(4) November 2020

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Chitons of the Salish Sea

Review of the living *Cinctura*

The *Canarium urceus* complex

Marginella, *Callipara*, and *Amphidromus*

Quarterly Publication of the San Diego Shell Club

ISSN 0738-9388

THE FESTIVUS

A publication of the San Diego Shell Club

Volume: 52 November 2020 ISSUE 4

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Club meetings are held on the third Thursday or Saturday of the month, except April, September and December, at either 7:30 p.m. in Room 104, Casa del Prado, Balboa Park, San Diego, or at 12:00 noon at other locations as noticed on the Club's website.

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FRONT COVER:
Mopalia spectabilis Cowan & Cowan, 1977, photographed live intertidally on rocks on June 15, 2014, by Roger Clark in Tacoma Narrows, Pierce County, Washinton. (Cover artistic credit: Rex Stilwill).

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November 21, 2020 - 1:00 p.m. "Save the Abalone!" event, potluck, and shell auction featuring shells from the Krattli legacy collection.

Publication date: October 31, 2020
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ISSN 0738-9388

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The shallow water chiton fauna of the Salish Sea

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ABSTRACT The Salish Sea, encompassing the inland waters of Washington State, and southern British Columbia, Canada, has one of the richest chiton faunas in the world, with nearly 40 species to be found in the intertidal and shallow subtidal depths, with a few only found on the outer fringe of Salish Sea, not in the inland waters.

KEY WORDS Salish Sea, chitons, biogeography, biodiversity, mollusca

INTRODUCTION

The Salish Sea (Figure 1), comprises the inland waters of Washington State and southern British Columbia, including Puget Sound, the Strait of Georgia, the Haro Strait, Desolation Sound, and the Strait of Juan de Fuca. At the heart of the Oregonian biogeographical province (Briggs & Bowen, 2011), this region has one of the World's richest and most diverse chiton faunas, with 39 species in 6 families to be found from the intertidal zone to moderate diving depths (< 30 m).

This region is undoubtedly the most intensely investigated region in the world for chitons with many large colorful species. Many of these have been illustrated in popular works by Burghardt & Burghardt (1969), Rice (1972), Harbo (2011) and Lamb & Hanby (2005), however an up to date check list has been lacking, and the taxonomy has not been updated since Kozloff (1987). The present systematic arrangement is based largely on Eernisse, Clark & Draeger (2007), except that it follows Sirenko & Clark (2008) in recognizing the family Protochitonidae Ashby, 1825.

The fauna includes some interesting genera of the family Mopaliidae, including two species of the carnivorous *Placiphorella,* stealthy, ambush predators (McLean, 1962, Clark, 1994), and the gigantic *Cryptochiton stelleri* (Middendorff, 1847) the largest chiton species in the world, and the only species in which the girdle completely covers the valves. It is also the center of distribution for the tiny cryptic brooder *Cyanoplax fernaldi* (Eernisse, 1986) of the family Lepidochitonidae.

A checklist summarizing the distribution of species within the Salish Sea based on my own investigations, and examination of the collections at the Royal British Columbia Museum, the Burk Museum, Santa Barbara Museum of Natural History, Los Angeles County Museum of Natural History and the California Academy of Sciences is presented in Table 1.

Relative abundance is based on a single (3 hour) intertidal search or a single SCUBA dive, and is given as follows: very rare = 0-1, rare = 1-2, uncommon = 3-10, common = 11-20, abundant = more than 20. Some species normally occur in deeper water but have been included here if their occurrence has been verified by me from <

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30 m depth. Likewise, I have included some species that are unknown from the inland waters of the Salish Sea but because this region is defined to include portions of more exposed coastline, of the outer portion of the Strait of Juan de Fuca, I have included them here but specify they are known only from more exposed habitats in the following species accounts.

SYSTEMATIC ACCOUNT

Class: Polyplacophora Gray, 1821
Subclass: Neoloricata Bergenhayn, 1955

Order: Lepidopleurida Thiele, 1909
Family: Leptochitonidae Dall, 1889
Genus: *Leptochiton* Gray, 1847
Leptochiton cascadiensis Sigwart & Chen, 2017
Leptochiton nexus Carpenter, 1864
Genus: *Hanleyella* Srirenko, 1973
Hanleyella oldroydi (Dall, 1919)
Family: Protochitonidae Ashby, 1825
Genus: *Deshayesiella* Carpenter [in Dall],1879
Deshayesiella spicata (Berry, 1919)

Order: Chitonida Thiele, 1909
Suborder: Chitonina Bergenhayn, 1930
Family: Chaetopleuridae Plate, 1899
Genus: *Chaetopleura* Shuttleworth, 1853
Chaetopleura gemma (Dall, 1879)
Family: Ischnochitonidae Dall, 1889
Genus: *Stenosemus* von Middendorff, 1847
Stenosemus albus (Linnaeus, 1767)
Genus: *Lepidozona* Pilsbry, 1892
Lepidozona cooperi (Suborder Carpenter [in Dall], 1879)
Lepidozona interstincta (Gould, 1852)
Lepidozona golischi (Berry, 1919)
Lepidozona radians (Carpenter, in Pilsbry, 1892)
Lepidozona mertensii (von Middendorff, 1847)
Lepidozona retiporosa (Carpenter, 1864)
Lepidozona willetti (Berry, 1917)
Genus: *Tripoplax* Berry, 1919
Tripoplax trifida (Carpenter, 1864)

Suborder: Acanthochitonina Bergenhayn, 1930
Family: Lepidochitonidae Iredale, 1914
Genus: *Cyanoplax* Pilsbry, 1892
Cyanoplax dentiens (Gould, 1846)
Cyanoplax fernaldi (Eernisse, 1986)
Family: Mopaliidae Dall, 1889
Genus: *Mopalia* Gray, 1847
Mopalia cirrata Berry, 1919
Mopalia egretta Berry, 1919
Mopalia ferreirai Clark, 1991
Mopalia hindsii (Reeve, 1847)
Mopalia imporcata Carpenter, 1864
Mopalia kennerleyi Carpenter, 1864
Mopalia lignosa (Gould, 1846)
Mopalia muscosa (Gould, 1846)
Mopalia phorminx Berry, 1919
Mopalia sinuata Carpenter, 1864
Mopalia spectabilis Cowan & Cowan, 1977
Mopalia swanii Carpenter, 1864
Mopalia vespertina (Gould, 1852)
Genus: *Dendrochiton* Berry, 1911
Dendrochiton flectens (Carpenter, 1864)
Dendrochiton semiliratus Berry, 1927
Genus: *Placiphorella* Dall, 1879
Placiphorella rufa Berry, 1917
Placiphorella velata Carpenter MS, Dall, 1879
Genus: *Tonicella* Carpenter, 1873
Tonicella insignis (Reeve, 1847)
Tonicella lineata (Wood, 1815)
Tonicella new sp., *cf. T. undocaerulea* Sirenko, 1973
Tonicella venusta Clark, 1999
Genus: *Katharina* Gray, 1847
Katharina tunicata (Wood, 1815)
Genus: *Cryptochiton* Middendorff, 1847
Cryptochiton stelleri (Middendorff, 1847)

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Figure 1. Map of Salish Sea.

SPECIES ACCOUNTS

Leptochiton cascadiensis Sigwart & Chen, 2017
(Plate 1, Figure 2; Plate 9, Figure 41)

Diagnosis. Very small chitons, to about 8 mm; valves whitish (often with orange or black mineral deposits), rounded, with longitudinal & radial rows of minute granules.
Habitat. Found on the bottoms of cobbles and boulders, as well as dead bivalve shells on muddy and sandy substrates from the mid-intertidal to depths of at least 50 m.
Distribution. Southeastern Alaska to Northern California.
Occurrence. Common to abundant, particularly along the Juan de Fuca Strait and in the San Juan Is., and Islands of the Georgia Strait. Less common elsewhere, rare or absent from the lower Puget Sound.
Comments. This small recently described species was previously confused with the more southern *Leptochiton rugatus* (Carpenter, in Pilsbry, 1892), found from central California to Baja California, Mexico.

Leptochiton nexus Carpenter, 1864
(Plate 1, Figure 3)

Diagnosis. Small chitons, 15-20 mm; valves brownish tones, with darker speckling;
rounded, with longitudinal & radial rows of minute granules; girdle with prominent, fine spicules.
Habitat. Found on the bottoms of cobbles, pebbles and dead bivalve shells resting on sand or mud substrates, at depths of 1-145 m, usually below 20 m in the Salish Sea.
Distribution. Kenai Peninsula, Alaska to The Sea of Cortez, Mexico.
Occurrence. Rare in the Salish Sea.
Comments. A larger, broader species than *L. cascadiensis.*

Haneyella oldroydi (Dall, 1919)
(Plate 1, Figure 4)

Diagnosis. Very small chitons, 6-8 mm; valves carinated & bearing minute pustules, whitish, (usually with black mineral deposits); girdle profusely covered with fine spicules.
Habitat. Found on pebbles and dead bivalve shells, on sand substrates at 30-450 m. Sometimes found on dead hexactinellid sponge skeletons in deeper depths.
Distribution. Sitka Sound, Alaska to Cabo San Quintin, Baja California, Mexico, and in the upper Sea of Cortez.
Occurrence. Rare in shallow (< 30 m) water, uncommon at deeper depths.
Comments. Known so far only from Desolation Sound and north of Nanaimo. Although I have

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not personally collected it in the Salish Sea, I have found it uncommonly at diving depths in southeastern Alaska, and at Monterey Bay, California.

Deshayesiella spicata (Berry, 1919)
(Plate 1, Figure 5)

Diagnosis. Moderately large chitons, 25-35 mm; uniformly brown in color, valves strongly "false beaked" (juga forward projecting); girdle with scattered, sharp spicules.
Habitat. Lives at 20-467 m on rocky and coral/sponge bottoms. In the northern extreme of its range this species lives on vertical rock walls with abundant sponges and corals at depths of 20-35 m.
Distribution. Vancouver, British Columbia to the Sea of Cortez.
Occurrence. Very rare, known so far in the Salish Sea from only two specimens (*leg.* Robert & Tammy Forsyth, 1995).

Chaetopleura gemma (Dall, 1879)
(Plate 1, Figures 6a-b)

Diagnosis. Small chitons, 10-20 mm; typically nearly uniformly green, black or orange, with a white striped black tail valve, sometimes mottled with other colors; valves with longitudinal and radial rows of minute pustules; girdle with fine, slender spicules.
Habitat. On tops or bottoms of cobbles, intertidal to 30 m or more.
Distribution. Moresby Island, B.C. to Baja California.
Occurrence. Uncommon to rare.
Comments. This species is very rare in the Salish Sea, but has been found at Port Gamble, WA, and near Victoria, B.C.

Stenosemus albus (Linnaeus, 1767)
(Plate 1, Figure 7)

Diagnosis. Small chitons, 10-15 mm; valves smooth except for growth lines; girdle pebbly appearing, scales cylindrical, juxtaposed; color solid white, usually with black mineral stains.
Habitat. On pebbles and dead bivalve shells resting on sand, silt or mud, 10-100 m (below 25 m in the Salish Sea).
Distribution. Arctic, circum-boreal, in the NE Pacific south to the Salish Sea.
Occurrence. Rare to uncommon.
Comments. May be confused with white specimens of *Lepidozona radians,* but distinguished by the unique, cylindrical girdle scales.

Lepidozona cooperi (Carpenter MS, Dall, 1879)
(Plate 1, Figure 8)

Diagnosis. Moderately large chitons, 30-40 mm; valves & girdle uniformly gray or dull green, carinated, central areas with longitudinal ribs, radial areas with rows of oblong tubercles; girdle with oval, convex, ribbed scales.
Habitat. Found on the bottoms of cobbles and boulders, intertidal to about 10 m.
Distribution. Vancouver Island to northern Baja California; outer straights of Juan de Fuca.
Occurrence. Common to abundant.

Lepidozona interstincta (Gould, 1852)
(Plate 1, Figures 9a-b)

Diagnosis. Small chitons, 15-25 mm; color shades of reddish-brown or pale orange with maroon and/or white markings, interior of valves white; valves smooth appearing, central areas radial areas with very faint riblets; girdle with small, slightly bent scales, with 10-12 riblets.
Habitat. On cobbles or dead bivalve shells, low intertidal to 60 m or more.

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Distribution. Cook Inlet, Alaska to at least southern Oregon.
Occurrence. Rare to common, particularly below 20 m.
Comments. Very similar to *Lepidozona radians,* (Plate 1, Figure 11a) but distinguished by the smaller scales and white interior of valves.

Lepidozona golischi (Berry, 1919)
(Plate 1, Figure 10a-b)

Diagnosis. Small, 20-25 mm; valves uniformly white, tan or pale orange, central areas with fine riblets, radial areas rather smooth (sometimes with 1-3 sulci), with a few scattered or incomplete rows of granules; girdle scales very small, with 14-16 fine riblets.
Habitat. Found on vertical rock walls, cobbles or shells, at 25-1400 m.
Distribution. Sitka, Baranof Island, Alaska to northern Baja California.
Occurrence. Very rare to rare. Most often obtained in deep water trawls.
Comments. I have taken a single specimen at 25 m on a wall, near Vancouver, British Columbia. Previously reported from Georgia Strait in deep water (217 m), by Cowan (1964).

Lepidozona radians (Carpenter in Pilsbry, 1892)
(Plate 1, Figure 11a; Plate 2, Figures 11b-e)

Diagnosis. Small chitons 20-30 mm; central areas microscopically pitted, radial areas with faint riblets; girdle with minute, roundly rectangular scales bearing about 12 fine striations; color vary variable, often streaked or speckled with olive, brown white, tan, blue and other colors, rarely solid white, interior of valves bluish.
Habitat. On bottoms of cobbles resting on or lightly buried in sand, low intertidal to 150 m.
Distribution: Sitka Sound, Baranof Island, Alaska to northern Baja California.
Occurrence. Rare to common, may be locally abundant.
Comments. Very similar to *L. interstincta*, (Plate 1, Figures 9a-b) but broader, and interior of valves bluish in color.

Lepidozona retiporosa (Carpenter, 1864)
(Plate 2, Figures 13a-d; Plate 9, Figure 45)

Diagnosis. Small, 10-15 mm (rarely to 20 mm); valves uniformly colored or mottle with reddish-brown, or orange tones, rarely cream; central areas finely pitted, radial areas with rows of fine (often obsolete) granules; girdle scales very small, with faint striations.
Habitat. On large cobbles, pebbles and dead bivalve shells, lowest intertidal to 1460 m.
Distribution. Cook Inlet, Alaska to southern Baja California Sur.
Occurrence. Very rare to uncommon intertidally, uncommon to common below 15 m.
Comments. This species is frequently dredged in deeper waters.

Lepidozona mertensii (von Middendorff, 1847)
(Plate 2, Figures 12a-e; Plate 9, Figures 44a-b)

Diagnosis. Moderately large chitons, 35-50 mm; valves carinated, variably colored, reddish, orange or purple tones, often speckled with white, rarely uniformly colored, or nearly uniform, with two white bands; central areas with strong longitudinal ribs and much weaker cross-ribbing, radial areas with rows of coarse rounded pustules; girdle scales large, convex, crowned with a short nipple.
Habitat. Found on the bottoms of cobbles and boulders, intertidal to 100 m.
Distribution. Cook Inlet to northern Baja California.
Occurrence. Common to abundant.

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Lepidozona willettii (Berry, 1917)
(Plate 2, Figures 14a-b)

Diagnosis. Small chitons, 25-30 mm; valves orange-brown, rarely with white markings; central areas with fine longitudinal riblets and finer cross-ribbing, radial areas with granule topped ribs, separated by sulci; girdle scales with 20-25 fine riblets, and crown with a striated nipple.
Habitat. Vertical rock walls, and cobbles resting on sand.
Distribution. Sitka Sound, Baranof Island, Alaska to northern Baja California, 20-275 m.
Occurrence. Rare to common, may be locally abundant.

Tripoplax trifida (Carpenter, 1864)
(Plate 3, Figures 15a-b)

Diagnosis. Moderately large 40-60 mm; valves mottled or maculated with orange, brown and white; central areas pitted, radial areas smooth, except for sulci; girdle scales large, smooth, bent.
Habitat. Vertical rock walls and boulders, intertidal to 110 m.
Distribution. Eastern Aleutian Islands to the Salish Sea.
Occurrence. Rare (intertidally) to common.
Comments. Previously listed as *Ischnochiton trifidus,* or *Lepidozona trifida.* Clark (2008b) raised the subgenus *Tripoplax* to full generic rank.

Cyanoplax dentiens (Gould, 1846)
(Plate 3, Figures 16a-d; Plate 9, Figure 43)

Diagnosis. Small chitons, 15-25 mm; valves evenly microgranular, variably colored and patterned, mucro of tail valve about central, post muscronal area slightly concave; gridle leathery appearing; gills extend to beneath suture of valves 2 & 3.
Habitat. Most often found at about 1 m or more above 0.0 tide level, on sides of boulders.
Distribution. Prince William Sound, Alaska to to San Luis Obispo County, California.
Occurrence. Uncommon to abundant.
Comments. Populations of this species show a wide range of colors and patterns.

Cyanoplax fernaldi (Eernisse, 1986)
(Plate 3, Figures 17a-b, Plate 9, Figure 42)

Diagnosis. Very small chitons, 8-15 mm; valves evenly granular, dark brown, often with white markings, rarely turquoise; mucro of tail valve central, postmucronal area convex; gills extending to beneath valve 4; girdle velvety appearing.
Habitat. Found at about 2 m above 0.0 tide level, nestled amongst barnacles and anemones.
Distribution. Yakobi Island, southeastern Alaska to Brookings, Curry County, Oregon.
Occurrence. Uncommon to rare, but may be locally abundant.
Comments. This tiny species is often overlooked because of its small size & nestling habit. One of the few brooding species of chiton on our coast (Eernisse, 1986, 1988).

Mopalia cirrata Berry, 1919
(Plate 3, Figures 18a-b)

Diagnosis. Small chitons, 20-25 m; with strongly pustulose radial ribs. Setae very long, up to one half of animal length, bearing usually strongly recurved, ringlet like bristles.
Habitat. Lives on the sides and bottoms of cobbles & boulders in relatively calm areas with good current or tidal exchange, and on rock walls, from the low intertidal (Hanselman, 1990) to at least 40 m.
Distribution. Found from Unalaska Island, Aleutian Islands, Alaska to San Mateo County, California.
Occurrence. Rare to uncommon.

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Comments. This species may be distinguished from the similar *M. sinuata* (Plate 9, Figures 27a-c) by 1) the strongly pustulose sculpture of the radial ribs, and 2) the very long setae, up to ½ of the animals length, bearing a single row of long, usually ringlet-like bristles.

Mopalia egretta Berry, 1919
(Plate 3, Figures 19a-b)

Diagnosis. Moderately large chitons (25-40 mm); valves typically brick red, with white or pale tan, rarely with blue streaks; setae, very sparce, relatively long, fine, slender, bearing long, slender, needle-like bristles.
Habitat. Occurs primarily on vertical rock walls at depths of 18-140 m.
Distribution. Kodiak Island, Alaska to Carmel Bay, California.
Occurrence. Rare to very rare.

Mopalia ferreirai Clark, 1991
(Plate 3, Figures 20a-c)

Diagnosis. Relatively large chitons, 40-60 mm; valves variably colored and patterned, setae with short bristles, giving a bushy look.
Habitat. On tops, sides and bottoms of boulders, and in crevices on rock walls, at depths of 1-18 m.
Distribution. From Kodiak Island, Alaska to Morro Bay, San Luis Obispo County, California.
Occurrence. Very rare in the Salish Sea, found only near the entrance of the Strait of Juan de Fuca, near Neah Bay, Washington and southwestern Vancouver Island, near Port Renfrew, B.C. and east to the vicinity of Victoria, B.C.
Comments. Previously confused with the southern *Mopalia lowei* Pilsbry, 1918, Clark (1991). Similar to *M. swanii* (Plate 5, Figures 29a-f), but has more delicate sculpture, and thicker setae which bear short, straight bristles on three sides.

Mopalia hindsii (Sowerby MS, Reeve, 1847)
(Plate 4, Figure 21a-b)

Diagnosis. Large chitons, 75-116 mm (largest of the *Mopalia*); valves with brown or green tones, sculpture fine; setae often fairly profuse, short, very fine with fine, straight bristles.
Habitat. On tops and sides of boulders, and in sea caves, mid-intertidal to 8 m.
Distribution. Kodiak Island, Alaska to Alamitos Bay, Los Angeles County, California.
Occurrence. Common to abundant.
Comments. Unusually large animals, reaching more than 100 mm are found at Indian Is., near Hadlock, WA.

Mopalia imporcata Carpenter, 1864
(Plate 4, Figures 22a-b)

Diagnosis. Small, 15-20 mm chitons; valves brown, green or yellow tones, strongly sculptured with longitudinal ribs and radial rows of rounded pustules, tail valve with posterior mucro; girdle with bushy, trough shaped setae bearing 4-5 profuse rows of relatively long, curved bristles.
Habitat. On sides & bottoms of boulders in areas of good tidal flow or strong currents, at 1-50 m.
Distribution. Kenai Peninsula, Alaska to northern Baja California, Mexico.
Occurrence. Rare, but may be locally uncommon.
Comments. Similar to *M. phorminx* but distinguished by 1) the round radial pustules, 2) the heavier setae, and 3) the posterior mucro of the tail valve.

Mopalia kennerleyi Carpenter, 1864
(Plate 4, Figure 23a-f; Plate 9, Figure 50)

Diagnosis. Relatively large, 50-65 mm; valves very variable in color and pattern, tail valve twice as broad as wide, indented posteriorly;

ISSN 0738-9388

girdle with strap-like setae bearing two rows of slender, white spicules.
Habitat. Tops, sides and bottoms of cobbles and boulders, intertidal to 10 m.
Distribution. Aleutian Islands, Alaska to northern California.
Occurrence. Common to abundant.
Comments. Previously confused with the more southern (central California to northern Baja) *Mopalia ciliata* (Sowerby II, 1840) Clark (2008a). Setae illustrated by A. Draeger, in Eernisse, *et al.* (2007).

Mopalia lignosa (Gould, 1846)
(Plate 4, Figure 24a-f; Plate 9, Figure 52)

Diagnosis. Relatively large chitons, 50-80 mm; valves carinated, smooth or finely pitted, streaked or feathered with brown and green, or black and white, rarely other colors; girdle with small recurved setae, usually bearing a single, sparse row of minute spicules.
Habitat. On sides and bottoms of cobbles & boulders, intertidal to 10 m.
Distribution. Cook Inlet, Alaska to central California (Morro Bay and San Miguel Island).
Occurrence. Common to abundant.
Comments. One of the Salish Sea's most variable and beautiful chitons.

Mopalia muscosa (Gould, 1846)
(Plate 5, Figure 25a-b)

Diagnosis. Large chitons, 60-90 mm; valves coarsely sculptured, dark brown, sometimes with lighter mottling; girdle profusely covered with stiff, brown pointed bristles.
Habitat. On tops of boulders and bedrock, high to mid-intertidal.
Distribution. Dall Island, southeastern Alaska, to northern Baja California, Mexico.
Occurrence. Uncommon to abundant.
Comments. The valves of this species are often very eroded. This species is very tolerable to drying, differences in temperature and salinity.

Mopalia phorminx Berry, 1919
(Plate 5, Figures 26a-b)

Diagnosis. Small chitons, 10-23 mm; valves tan or light brown (often with darker markings), bearing radial rows of triangular, downwardly directed pustules, tail valve with mucro of tail valve post central; girdle with slender setae bearing long, slender bristles.
Habitat. Found on cobbles, dead bivalve shells, and dead wood fragments at 18-130 m.
Distribution. Prince William Sound, Alaska to San Pedro Bay, California.
Occurrence. Rare to very rare.
Comments. This species may be distinguished from the similar *M. imporcata* (Plate 4, Figures 22a-b) by 1) the unique, triangular pustules, large diagonal and posterior rows with similar but smaller rows between, 2) fine setae and 3) the sub-central position of the mucro of the tail valve.

Mopalia sinuata Carpenter, 1864
(Plate 5, Figures 27a-c; Plate 9, Figure 46)

Diagnosis. Small chitons, rarely exceeding 20 mm; valves with reddish, green and brown mottlings, bearing strong raised radial ribs, central areas pitted; setae long, thick, bearing two laterally recurved rows of bristles.
Habitat. On sides of cobbles and boulders, and in rocky crevices in areas of good tidal exchange or swift currents, from the intertidal to 60 m.
Distribution. Kenai Peninsula, Alaska to San Luis Obispo County, California.
Comments. Similar to *Mopalia cirrata*, but distinguished by the smoother sculpture and feather-like setae.

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Mopalia spectabilis Cowan & Cowan, 1977
(Plate 5, Figures 28a-d)

Diagnosis. Large chitons, 50-70 mm; valves typically light green, with red flecks and brilliant blue zigzag lines, rarely nearly solid orange; setae relatively long, bushy, trough-shaped, bearing five rows of long, recurved bristles.
Habitat. On the sides and bottoms of loose cobbles and boulders, as well as in sea caves and on rock walls, intertidal to 30 m.
Distribution. Kodiak Island, Alaska to Santa Barbara County, California.
Comments. This large colorful species is unlikely to be confused with other members of the genus.

Mopalia swanii Carpenter, 1864
(Plate 5, Figure 29a-f; 5, Plate 9, Figure 51)

Diagnosis. Large chitons, to 60 mm; valves variably colored and patterned, sculpture fine, central areas pitted; setae very small < 2 mm, with fine, recurved bristles.
Habitat. Found on the bottoms of cobbles and boulders, and on rock walls, intertidal to 30 m.
Distribution. Unalaska Island, Aleutian Islands, Alaska to San Francisco Bay, California.
Comments. This colorful species is a voracious, omnivorous grazer, often found scowering barnacles, sponges, ascidians and all other invertebrates and algae down to the bedrock.

Mopalia vespertina (Gould, 1852)
(Plate 6, Figure 30a-e)

Diagnosis. Large chitons, 60-80 mm; valves smooth or nearly smooth, sometimes with weakly beaded radials; color usually greenish or brown tones, sometimes purplish or white; interior of valves white usually flushed with pink at the apices; girdle encroaching nearly to valve apices, bearing short fine bristles with fine, strongly recurved bristles.
Habitat. On tops, sides and bottoms of rocks and boulders, intertidal to 30 m.
Distribution. Sitka, Alaska to Morro Bay, California.
Occurrence. Uncommon to abundant.
Comments. Similar to *Mopalia hindsii* (Plate 4, Figures 21a-b) and *Mopalia lignosa* (Plate 4, Figures 24a-f), but distinguished by the setae which have very fine, strongly recurved bristles.

Dendrochiton flectens (Carpenter, 1864)
(Plate 6, Figures 31a-c)

Diagnosis. Small chitons, 10-20 mm, rarely to 30 mm; plates microgranular, variably colored, with blue, green, red and orange, often mottled or nearly uniform in color, with blue spots on edges of valves; girdle fleshy, with a single, medial row of setae, often only around valves 7-8, bearing a single row of recurved bristles.
Habitat. On tops, sides and bottoms of cobbles and boulders.
Distribution. Kenai Peninsula, Alaska to Isla San Geronimo, Baja California, Mexico (Ferreira, 1980), low intertidal to 50 m.
Occurrence. Patchy, rare to common.
Comments. Another small colorful species.

Dendrochiton semiliratus Berry, 1927
(Plate 6, Figure 32)

Diagnosis. Small chitons, 10-12 mm, rarely to 15 mm; valves subcarinated, lateral areas scarcely defined, central areas with 6-12 narrow, longitudinal ribs, most not reaching the posterior edge of the valves; color shades are reddish or cinnamon, rarely with some cream colored valves; setae sparce, fine, with a few fine, slender bristles.
Habitat. Found on clean (silt free) cobbles resting on sand, at depths of 25-130 m.

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Distribution. Sitka Sound, Baranof Island, Alaska to Santa Catalina Island, California.
Occurrence. Rare, but may be locally common.
Comments. Very similar to *D. flectens* (Plate 6, Figures 31a-c), but distinguished by the ribbed central areas.

Placiphorella rufa Berry, 1917
(Plate 6, Figure 33)

Diagnosis. Large chitons, 40-50 mm, but can reach 80 mm; outline broadly oval, valves uniformly reddish or pink; girdle very broadly expanded anteriorly, scaled setae restricted to margin of girdle.
Habitat. Found on boulders and bedrock (often on wall ledges) at 20-50 m.
Distribution. Central Aleutian Islands, Alaska to Southern Oregon 1-140 m.
Occurrence. Uncommon to rare.
Comments. This species was first reported in the Salish Sea by Anderson, 1993. In the Salish sea it is typically found below 18 m.

Placiphorella velata Carpenter MS, Dall, 1879
(Plate 6, Figure 34)

Diagnosis. Large, 40-50 mm, but can reach over 70 mm; outline broadly oval, valves variously streaked with brown, white, pink and green; girdle broadly expanded anteriorly, sparsely covered with scaly setae.
Habitat. Found on boulders and bedrock, from the intertidal to at least 30 m.
Distribution. Cook Inlet and Prince William Sound, Alaska to northern Baja California.
Occurrence. Uncommon to abundant.
Comments. *P. velata* is only rarely found in interior waters, but is often quite common in coastal areas.

Tonicella insignis (Reeve, 1847)
(Plate 7, Figure 35; Plate 9, Figure 48)

Diagnosis. Relatively large chitons, 35-40 mm, but can reach 60 mm; valves smoothish, red, with transvers, white zigzag lines on central areas.
Habitat. found on the sides and tops of boulders, from the low intertidal to at least 50 m.
Distribution. Unalaska Island, Aleutian Islands, Alaska to Oregon.
Occurrence. Uncommon to common, may be locally abundant.
Comment. This is perhaps the most strikingly beautiful chiton on the entire Pacific coast.

Tonicella lineata (Wood, 1815)
(Plate 7, Figures 36a-f; Plate 9, Figure 49)

Diagnosis. Relatively large chitons, to about 50 mm; valves smoothish, variably patterned, usually with maroon-black, red-orange & white longitudinal lines, dark lines on head valve forming a gothic arch; Solid white specimens are blue, green or purple in life.
Habitat. On tops, sides and bottoms of cobbles and boulders, and on bedrock and rock walls, especially those covered with encrusting coralline red algae, intertidal to about 10 m.
Distribution. Adak Island, Aleutian Islands, Alaska, to central California.
Occurrence. Common to abundant.
Comments. Another of the most strikingly beautiful chitons of the Salish Sea.

Tonicella cf. undocaerulea Sirenko, 1973
(Plate 7, Figure 37a-c)

Diagnosis. Medium sized chitons, 20-30 mm, rarely to 40 mm; valves light orange, with zigzag white lines (brilliant blue in life), and maroon streaks on pleural areas, post mucronal area of tail valve variable, convex to concave; girdle fleshy.

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Habitat. Lives on sides and tops of rocks encrusted with coralline algae, from low intertidal zone to at least 45 m.
Distribution. Kodiak Island, Alaska, to Monterey Bay, California.
Occurrence. Rare to common.
Comments. In a previous review of the *Tonicella lineata* species complex (Clark 1999), this colorful species was identified as *Tonicella undocaerulea*, whose type locality is in Japan, but since then some subtle morphological distinctions and molecular differences have been noted, and its species status has been further investigated (R.N. Clark and D.J. Eernisse, in prep.). Whether or not it is a separate species, it is separated by several thousand kilometers from the nearest northwestern Pacific populations of *T. undocaerulea*.

Tonicella venusta Clark, 1999
(Plate 7, Figures 38a-b; Plate 9, Figure 47)

Diagnosis. A small species, 10-17 mm; valves light orange or pinkish, with white (blue or purple in life) zigzag lines, pleural areas usually with large white, triangular markings; girdle sandy appearing due to the dense calcareous elements
Habitat. Lives on sides and tops of boulders encrusted with coralline algae, *Lithothamnion spp.* from extreme low intertidal zone to at least 140 m.
Distribution. Kodiak Island, Alaska to Isla Cedros, Baja California, Mexico.
Occurrence. Rare to uncommon.
Comments. Another small, but very colorful species. Differs from *Tonicella cf. undocaerulea*, (Plate 7, Figures 37a-c) by the sandy girdle and lack of maroon-black markings on plates.

Katharina tunicata (Wood, 1815)
(Plate 8, Figures 40a-b)

Diagnosis. Very large 80-110 mm chitons, only 1/3 portion (usually eroded) of valves exposed through shiny black girdle.
Habitat. On tops and sides of cobbles and boulders, middle to upper intertidal areas.
Distribution. Aleutian Islands to northern Channel Islands, California.
Occurrence. Common to abundant.
Comments. One of the largest and most recognizable chitons on the Pacific coast.

Cryptochiton stelleri (von Middendorff, 1847)
(Plate 8, Figure 39a-c; Plate 9, Figure 54)

Diagnosis. Very large, 250-350 mm, but can reach over 400 mm. velvety girdle completely covering the valves; color often solid brick red-brown, but may be golden or gray, sometimes red mottled with gray-white or orange.
Habitat. Found on rock or sand, intertidal to at least 80 m.
Distribution. NE Hokkaido Island, Japan to northern Channel Islands, California.
Occurrence. Uncommon to abundant.
Comments. This is by far the largest species of chiton in the world.

ACKNOWLEDGEMENTS

I am grateful to Dr. Philip Lambert and Kelly Sendall (retired), Royal British Columbia Museum, Victoria; Dr. Alan Kohn, Burke Museum, University of Washington, Seattle (emeritus); Elizabeth Kools, California Academy of Sciences; Dr. Jann Vendetti and Lindsey Groves, Los Angeles County Museum of Natural History; and Dr. Henry Chaney and Dr. Daniel Geiger, Santa Barbara Museum of Natural History; and Rick Harbo, Nanaimo, B.C. I also thank the two anonymous reviewers for their comments.

ISSN 0738-9388

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ISSN 0738-9388

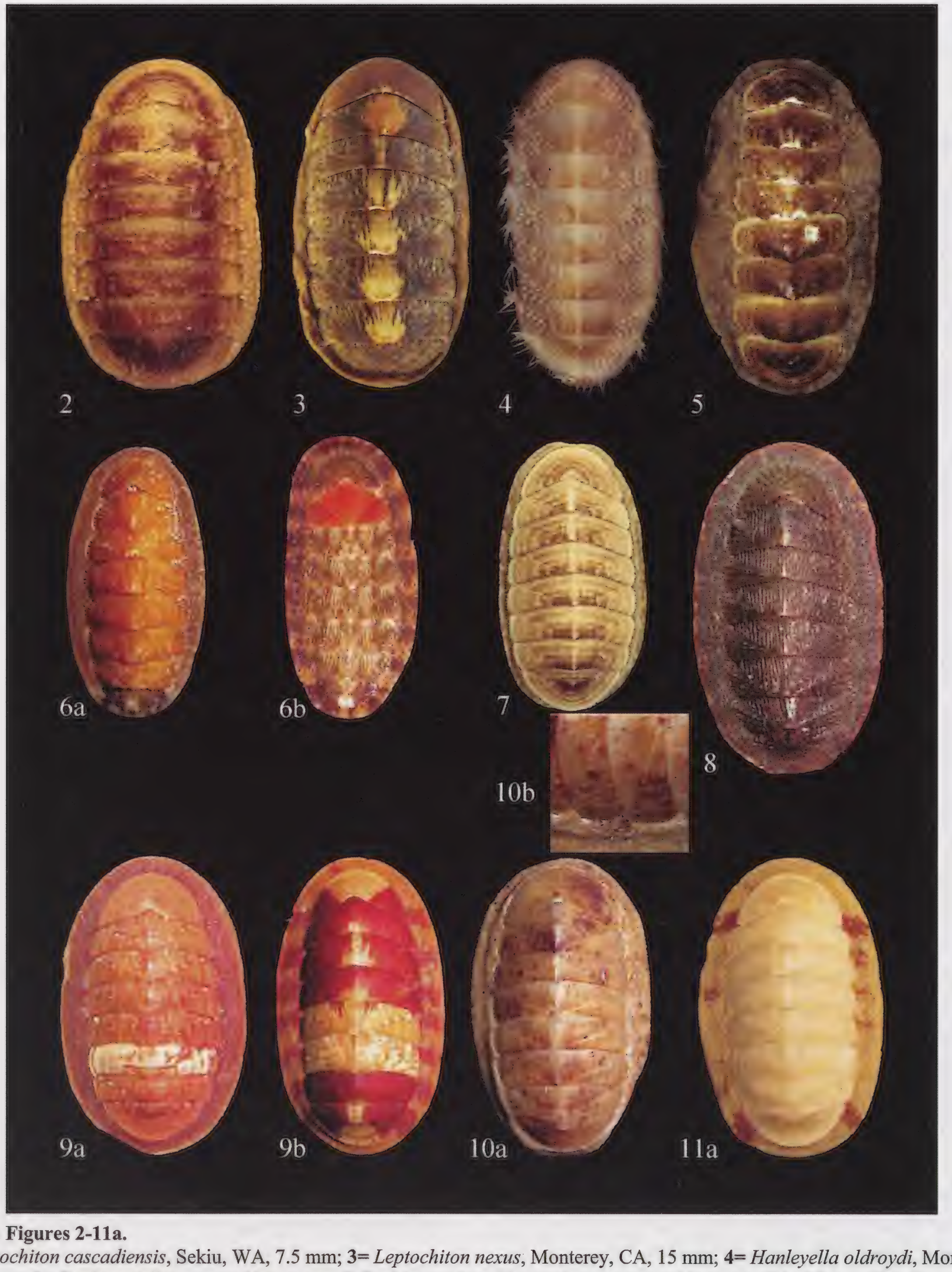

Plate 1. Figures 2-11a.
2= *Leptochiton cascadiensis*, Sekiu, WA, 7.5 mm; **3**= *Leptochiton nexus*, Monterey, CA, 15 mm; **4**= *Hanleyella oldroydi*, Monterey, CA, 7 mm; **5**= *Deshayesiella spicata*, Vancouver, B.C., 34 mm; **6a**= *Chaetopleura gemma*, Monterey, CA, 17 mm; **6b**= *C. gemma*, Ucluelet, B.C., 16 mm; **7**= *Stenosemus albus*, Kachemak Bay, AK, 15 mm; **8**= *Lepidozona cooperi*, Makkaw Bay, WA, 25 mm; **9a**= *Lepidozona interstincta*, San Juan Is., WA, 21 mm; **9b**= *L. interstincta*, Port Gamble, WA, 22 mm; **10a**= *Lepidozona golischi*, Vancouver, B.C., 22.5 mm; **10b**= *L. golischi*, close up of valve sculpture; **11a**= *Lepidozona radians*, Brookings, OR, 20.5 mm.

ISSN 0738-9388

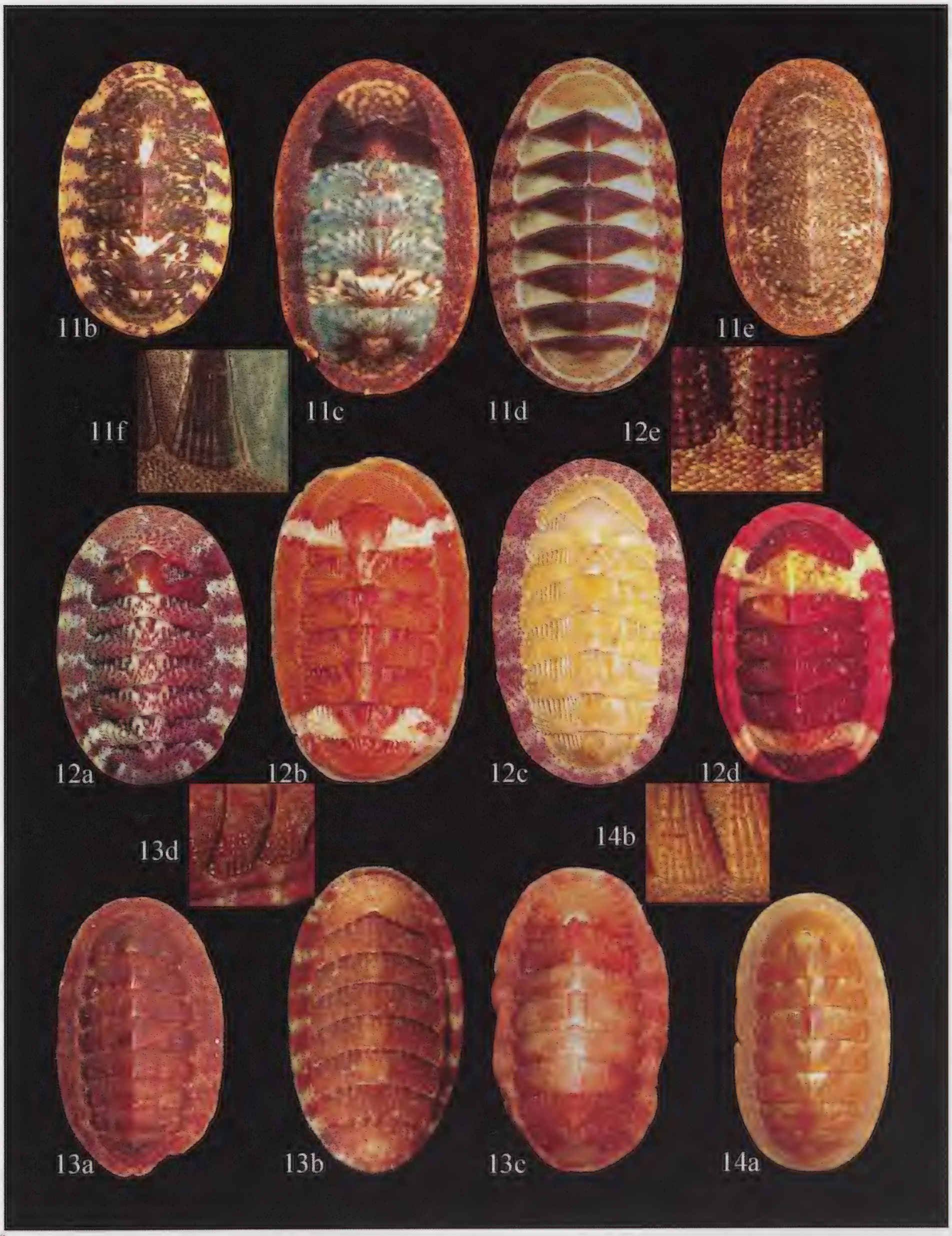

Plate 2. Figures 11b-14.
11b= *Lepidozona radians*, Monterey, CA, 26 mm; **11c=** *L. radians*, Baja California, 23 mm; **11d=** *L. radians,* Monterey, CA, 21 mm; **11e=** *L. radians*, Monterey, CA, 23 mm; **11f=** *L. radians*, close-up of valve sculpture; **12a=** *Lepidozona mertensii*, Timber Cove, CA, 38 mm; **12b=** *L. mertensii*, Franklin Point, CA, 26 mm; **12c=** *L. mertensii*, Hadlock, WA, 30 mm; **12d=** *L. mertensii*, Sitka, AK, 29 mm; **12e=** *Lepidozona mertensii*, close-up of valve sculpture; **13a=** *Lepidozona retiporosa*, Tacoma, WA, 16 mm; **13b=** *L. retiporosa*, San Pedro Bay, CA, 24 mm; **13c=** *L. retiporosa*, Vancouver Is., B.C., 14.5 mm; **13d=** *L. retiporosa*, close-up of valve sculpture; **14a=** *Lepidozona willetti*, Ketchikan, AK, 28 mm; **14b=** *L. willetti*, close-up of valve sculpture.

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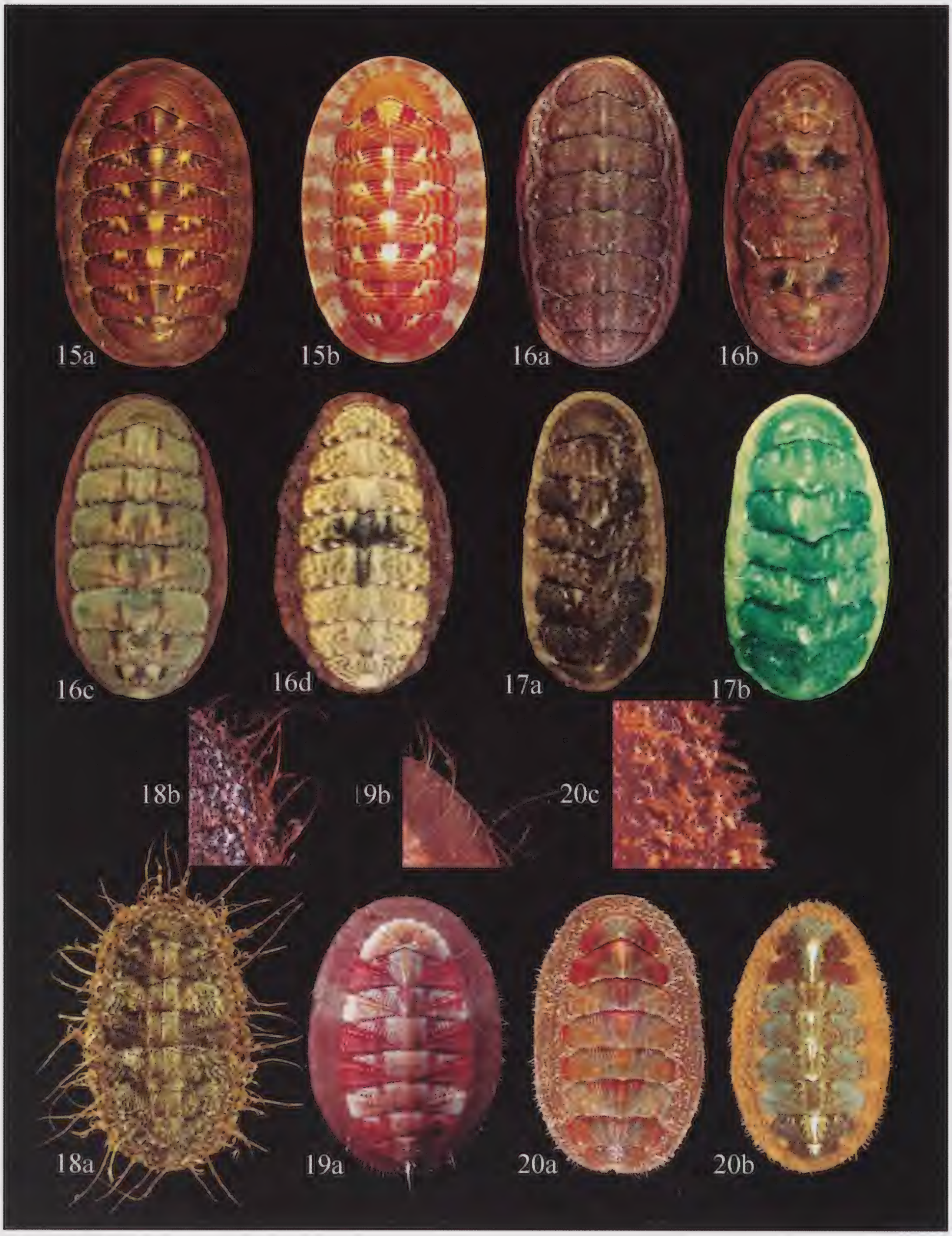

Plate 3. Figures 15-20.
15a= *Tripoplax trifida*, Vancouver, B.C., 44 mm; **15b=** *T. trifida*, Kodiak, AK, 41 mm; **16a=** *Cyanoplax dentiens*, Point Delgado, CA, 19 mm; **16b=** *C. dentiens*, Sitka, AK, 15 mm; **16c=** *C. dentiens*, Sitka, AK, 17 mm; **16d=** *C. dentiens,* Point Delgado, CA, 15 mm; **17a=** *Cyanoplax fernaldi*, Tacoma, WA, 8 mm; **17b=** *C. fernaldi*, Tacoma, WA, 6 mm; **18a=** *Mopalia cirrata,* Cape Arago, OR, 17 mm; **18b=** *M. cirrata*, close-up of setae; **19a=** *Mopalia egretta*, Ketchikan, AK, 23 mm; **19b=** *M. egretta*, close-up of setae; **20a=** *Mopalia ferreirai*, Metlakla, AK, 44 mm; **20b=** *M. ferreirai*, Monterey, CA, 35 mm; **20c=** *M. ferreirai*, close-up of setae.

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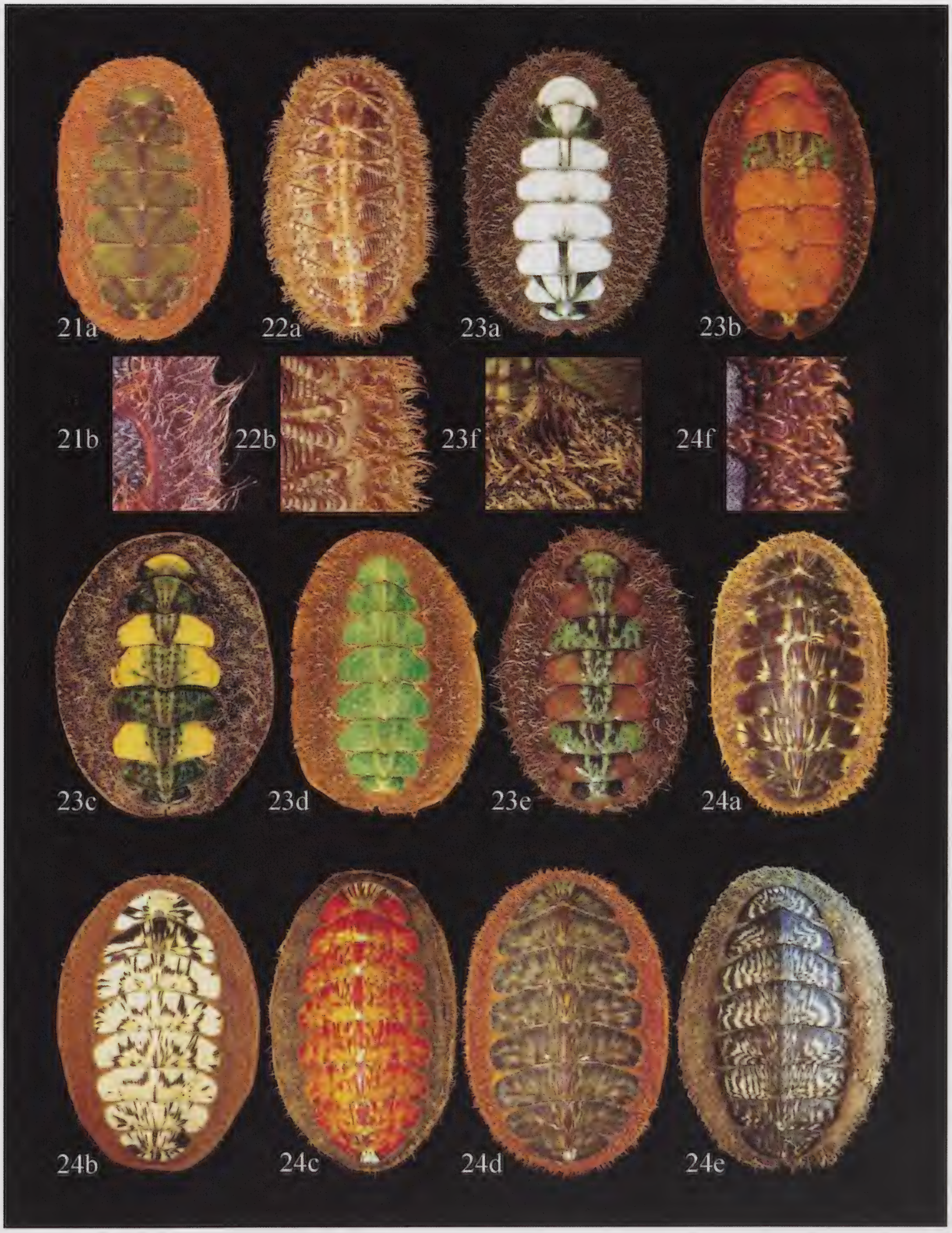

Plate 4. Figures 21-24.
21a= *Mopalia hindsii*, Monterey, CA, 50 mm; **21b**= *M. hindsii*, close-up of setae; **22a**= *Mopalia imporcata*, Port Gamble, WA, 18 mm; **22b**= *M. imporcata*, close-up of setae; **23a**= *Mopalia kennerleyi*, Ketchikan, AK, 42 mm; **23b**= *M. kennerleyi*, Point Arena, CA, 37 mm; **23c**= *M. kennerleyi*, Port Hardy, B.C., 48 mm. **23d**= *M. kennerleyi*, Port Gamble, WA, 50 mm; **23e**= *M. kennerleyi,* Adak Island, AK, 41 mm; **23f**= *M. kennerleyi*, close-up; **24a**= *Mopalia lignosa*, Metlakatla, AK, 53 mm; **24b**= *M. lignosa*, Tacoma, WA, 49 mm; **24c**= *M. lignosa*, Tacoma, WA, 55 mm; **24d**= *M. lignosa*, Brookings, OR, 41 mm; **24e**= *M. lignosa*, Hadlock, WA, 58 mm; **24f**= *M. lignosa*, close-up of setae.

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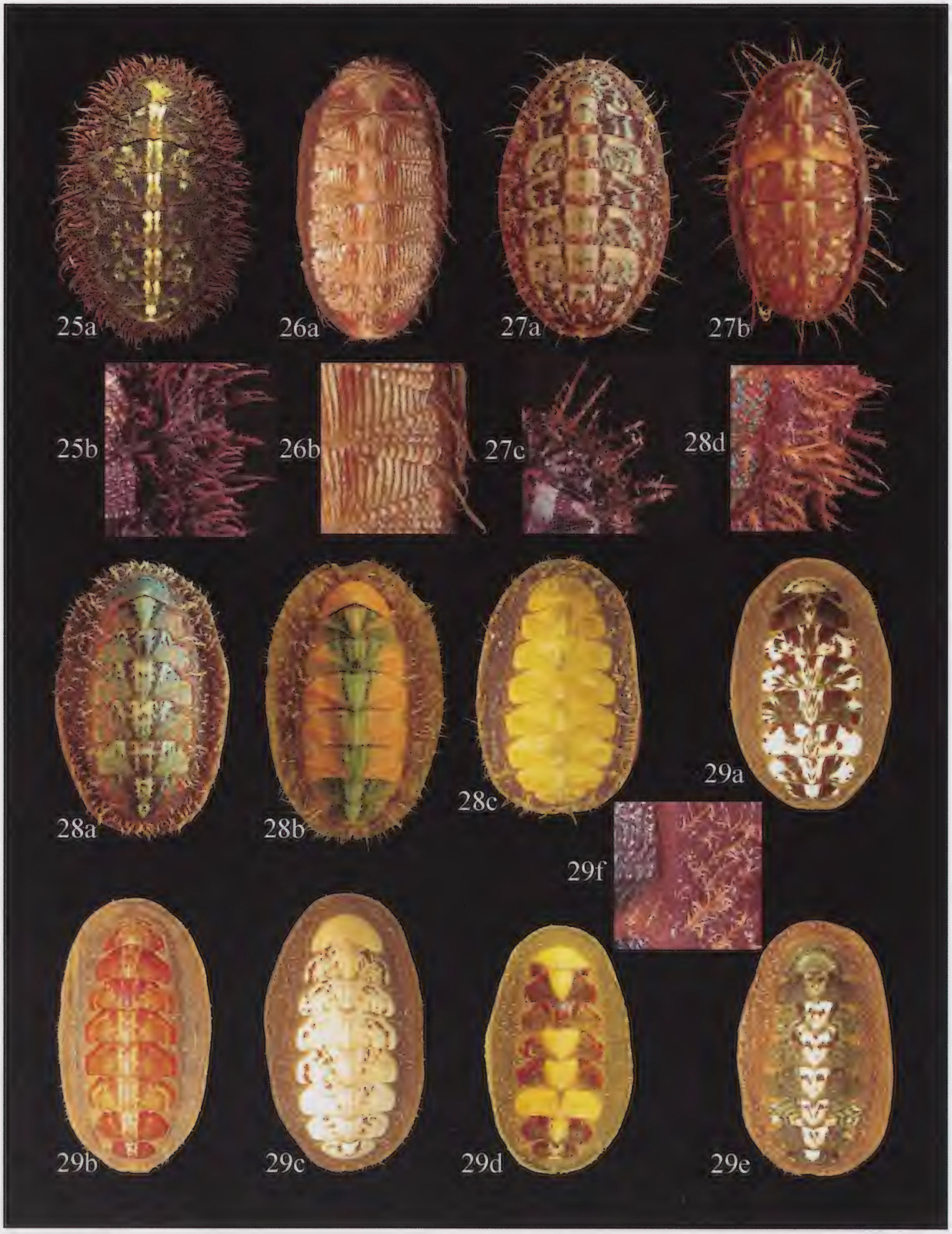

Plate 5. Figures 25-29.
25a= *Mopalia muscosa*, Morro Bay, CA, 44 mm; **25b**= *M. muscosa*, close-up of setae; **26a**= *Mopalia phorminx*, Ketchikan, AK, 16 mm; **26b**= *M. phorminx*, close-up of setae; **27a**= *Mopalia sinuata*, Port Gamble, WA, 17 mm; **27b**= *M. sinuata*, Lopez Island, WA, 18 mm; **27c**= *M. sinuata*, close-up of setae; **28a**= *Mopalia spectabilis*, Tacoma WA, 46 mm; **28b**= *M. spectabilis*, Moss Beach, CA, 43 mm; **28c**= *M. spectabilis*, Hadlock, WA, 47 mm; **28d**= *M. spectabilis*, close-up of setae; **29a**= *Mopalia swanii*, Coos Bay, OR, 41 mm; **29b**= *M. swanii,* close-up of setae; **29c**= *M. swanii*, San Juan Is., WA, 42 mm; **29d**= *M. swanii*, Coos Bay, OR, 35 mm; **29e**= *M. swanii*, Hadlock, WA, 35 mm; **29f**= *M. swanii*, Coos Bay, OR, 35 mm.

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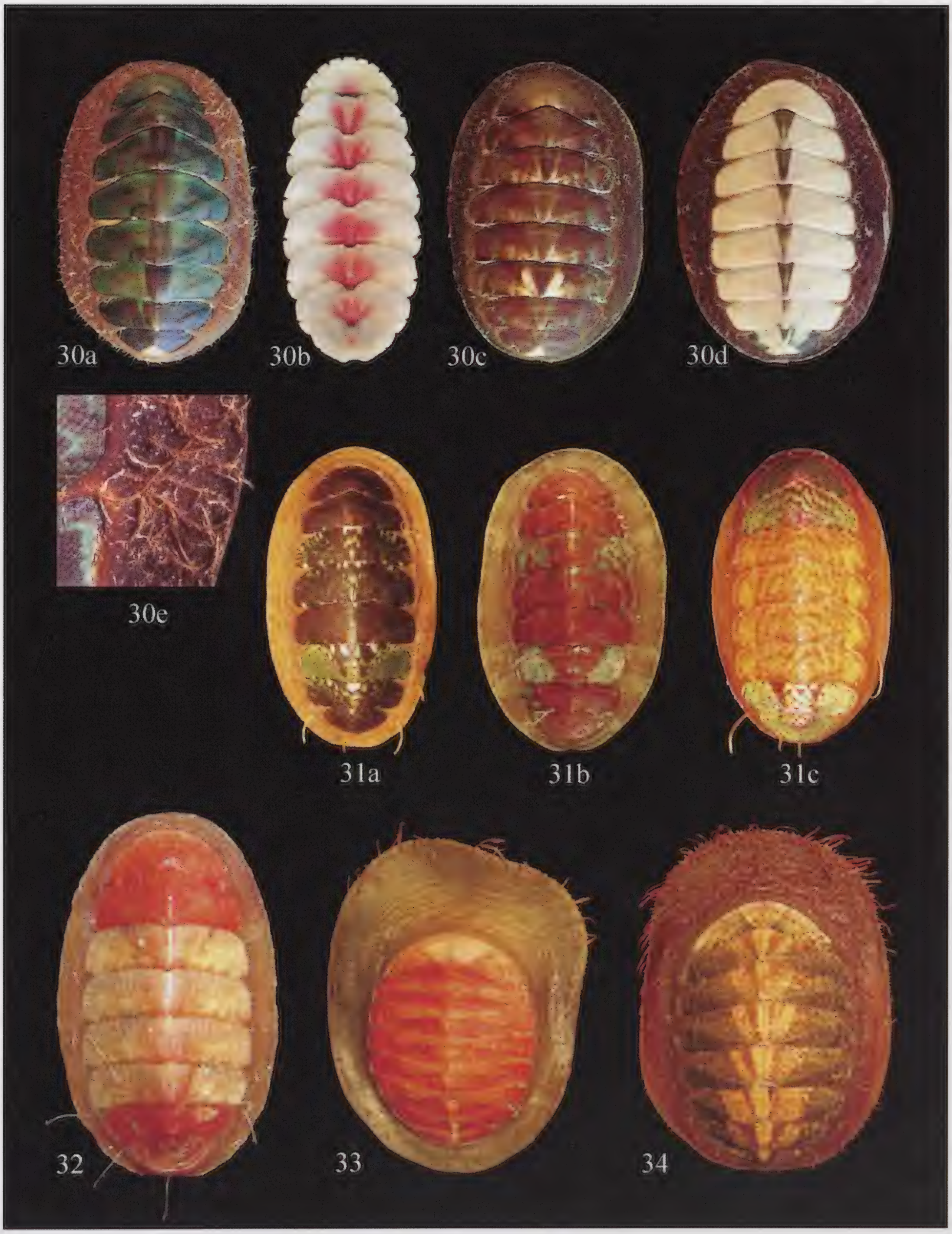

Plate 6. Figures 30-34.
30a= *Mopalia vespertina*, Port Gamble, WA, 48 mm; **30b**= *M. vespertina,* interior of valves; **30c**= *M. vespertina,* Port Gamble, WA, 38 mm; **30d**= *M. vespertina,* Port Gamble, WA, 43 mm; **30e**= *M. vespertina*, close-up of setae; **31a**= *Dendrochiton flectens*, Monterey Bay, CA, 23 mm; **31b**= *D. flectens*, Ketchikan, AK, 16 mm; **31c**= *D. flectens*, Pidgeon Point, CA, 17 mm; **32**= *Dendrochiton semiliratus*, Metlakatla, AK, 8 mm; **33**= *Placiphorella rufa*, Ketchikan, AK, 35 mm; **34**= *Placiphorella velata*, Neah Bay, WA, 60 mm.

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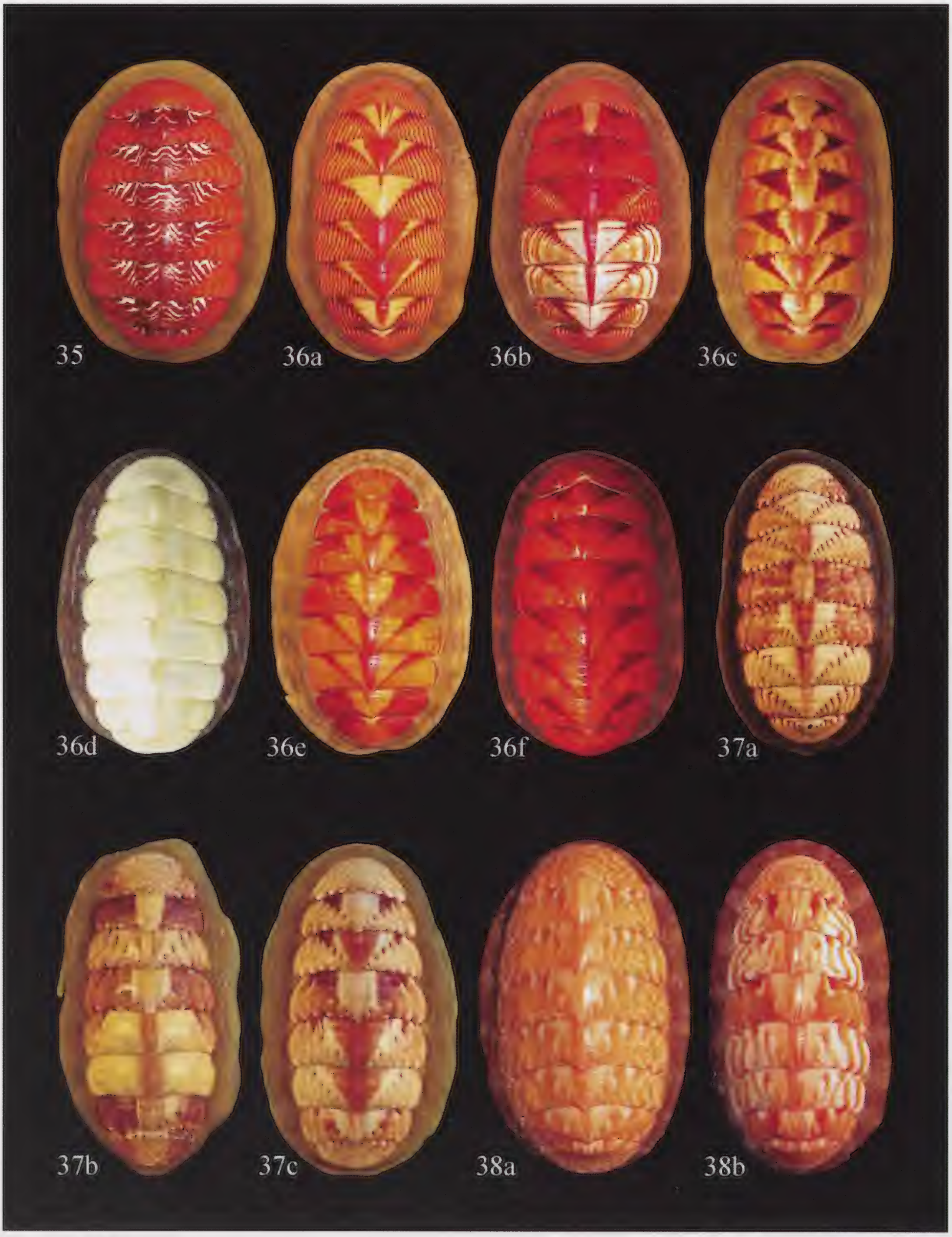

Plate 7. Figures 35-38.
35= *Tonicella insignis,* Tacoma, WA, 55 mm; **36a=** *Tonicella lineata,* Tacoma, WA, 40 mm; **36b=** *T. lineata,* Tacoma, WA, 44 mm; **36c=** *T. lineata,* Tacoma, WA, 48 mm; **36d=** *T. lineata,* Victoria, B.C., 21 mm; **36e=** *T. lineata,* Tacoma, WA, 38 mm; **36f=** *T. lineata,* Bowen Is., B.C., 38 mm; **37a=** *Tonicella cf. undocaerulea.* Broughton Strait, B.C., 40 mm; **37b=** *T. cf. undocaerulea,* Ketchikan, AK, 24 mm; **37c=** *T. cf. undocaerulea*. Turn Island, WA, 36 mm; **38a=** *Tonicella venusta,* Victoria, B.C., 17 mm; **38b=** *T. venusta,* Tofino Sound, B.C., 15 mm.

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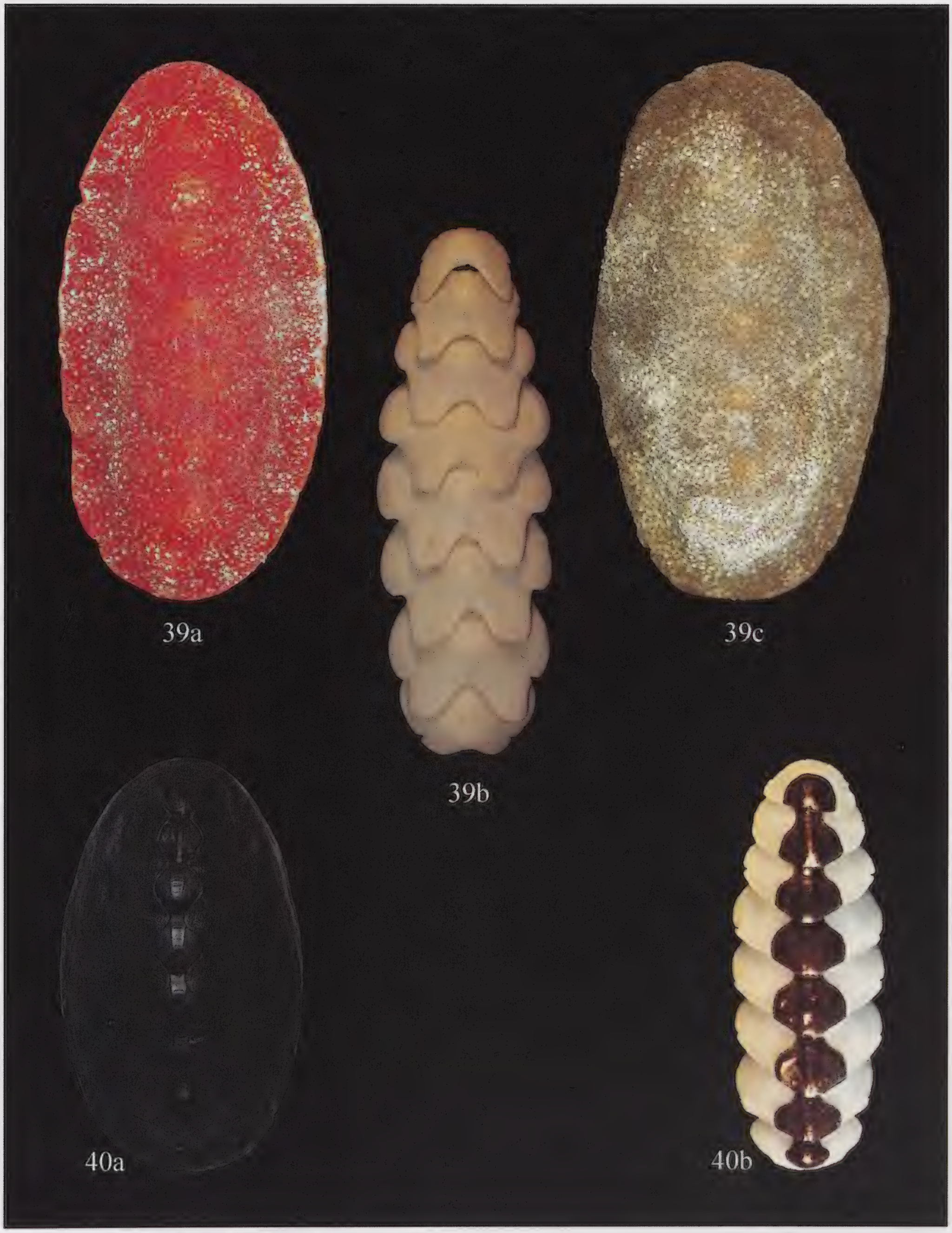

Plate 8. Figures 39-41.
39a= *Cryptochiton stelleri,* Brookings, OR, 73 mm; **39b=** *C. stelleri,* articulated valves; **39c=** *C. stelleri,* Tacoma, WA, 113 mm; **40a=** *Katharina tunicata,* Coos Bay, OR, 80 mm; **40b=** *K. tunicata,* articulated valves.

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Plate 9 (live animals, in situ – all intertidal). Figures 41-54.
41= *L. cascadiensis* – Sekiu, WA; **42=** *C. fernaldi* – Tacoma, WA; **43=** *C. dentiens* – Sekiu, WA; **44 A-B=** *L. mertensii* – Hadlock, WA; **45=** *L. retiporosa* – Tacoma, WA; **46=** *M. sinuata* – Port Gamble, WA; **47=** *T. venusta* – Neah Bay, WA; **48=** *T. insignis* - Tacoma, WA; **49=** *T. lineata* (albino) – Neah Bay, WA; **50=** *M. kennerleyi* – Tacoma, WA; **51=** *M. swanii* – Hadlock, WA; **52=** *M. lignosa* – Tacoma, WA; **53=** *P. velata* – Neah Bay, WA; **54=** *C. stelleri* – Tacoma, WA.

ISSN 0738-9388

Taxon	DS	NA	JI	VA	SO	VI	SJI/GI	PWN	HA	PG	A	S	NB	SE	TA	OL
L. cascadensis	X	X			X	X	X	X			X	X	X			
L. nexus		X	X			X	X									
H. oldroydi	X	X														
D. spicata				X												
C. gemma							X			X			X			
S. albus	X						X									
L. cooperi												X	X			
L. interstincta	X	X	X			X	X		X		X		X		X	
L. golischi				X												
L. radiens		X			X	X	X	X					X			
L. mertensii	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
L. retiporosa	X	X	X			X	X		X	X	X		X		X	
L. willetti				X												
T. trifida			X	X		X	X			X			X		X	
C. dentiens					X	X	X		X	X	X	X	X	X	X	
C. fernaldi					X	X	X						X		X	
M. cirrata		X				X	X		X	X			X		X	
M. egretta		X		X		X	X									
M. ferreirai					X	X	X						X			
M. hindsii	X	X		X	X	X	X		X	X	X	X	X	X	X	
M. imporcata		X				X	X		X	X	X				X	
M. kennerleyi	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
M. lignosa	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M. muscosa	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M. phorminx							X									
M. sinuata		X		X		X	X		X	X	X		X			
M. spectabilis		X	X	X	X	X	X		X	X	X	X	X		X	
M. swanii	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
M. vespertina	X	X	X	X	X	X	X		X	X	X	X	X	X	X	
D. flectens		X			X	X	X	X	X	X		X	X		X	
D. semiliratus		X														
P. rufa			X				X						X			
P. velata					X		X						X			
T. insignis	X	X	X	X		X	X		X	X		X	X		X	
T. lineata	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
T. cf. undocaerulea		X		X	X	X	X	X	X	X			X			
T. venusta		X				X	X						X			
K. tunicata	X	X		X	X	X	X	X	X	X		X	X	X	X	
C. stelleri	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 1. DS= Desolation Sound, BC; **NA**= Nanaimo, BC; **JI**= Jervis Inlet; **VA**= Vancouver, BC; **SO**= Sook, BC; **VI**= Victoria, BC; **SJI/GI**= San Juan Islands, WA/Gulf Islands, BC; **PWN**= Port Washington Narrows; **HA**= Hadlock (Oak Bay/Indian Island), WA; **PG**= Port Gamble, WA; **A**= Anacortes, WA.; **S**= Sekiu, WA; **NB**= Neah Bay, WA; **SE**= Seattle, WA; **TA**= Tacoma, WA; **OL**= Olympia, WA.

ISSN 0738-9388

Volume: 52 THE FESTIVUS ISSUE 4

A Review of the Living *Cinctura* Banded Tulip Shells (Gastropoda: Fasciolariidae), with the Descriptions of Four New Subspecies and a New Subgenus

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ABSTRACT The fasciolariid genus *Cinctura* Hollister, 1957, which is endemic to the Carolinian Molluscan Province, is now known to contain five distinct species: *C. hunteria* (Perry, 1811); *C. keatonorum* Petuch, 2014; *C. lilium* (Fischer von Waldheim, 1807); *C. tortugana* (Hollister, 1957); and *C. branhamae* (Rehder and Abbott, 1951). Four new geographical subspecies are described, *C. hunteria apalachee* Petuch and Berschauer, n. subsp. (Florida Panhandle to Mobile Bay), and three subspecies from deep water along the eastern edge of the Campeche Escarpment in the Yucatan Channel: *C. lilium connori* Petuch and Berschauer, n. subsp.; *C. tortugana traciae* n. subsp.; and *C. branhamae morganae* Petuch and Berschauer, n. subsp. The new subgenus *Hollisteria* Petuch and Berschauer, n. subgen. is proposed for the elongated, fragile deep water species of the *Cinctura branhamae* Complex.

KEY WORDS *Cinctura*, *C. hunteria apalachee*, *C. lilium connori*, *C. tortugana traciae*, *C. branhamae morganae*, *Hollisteria*, Fasciolariidae, Carolinian Molluscan Province, Gulf of Mexico

INTRODUCTION

The genus *Cinctura* (Hollister, 1957), the iconic "Banded Tulip Shells" of the southeastern United States and eastern Mexico, contains five known species and four subspecies and is entirely confined to the Carolinian Molluscan Province (Figure 1). Although the genus ranges from Cape Hatteras, North Carolina to Isla Contoy, Yucatan Peninsula, Mexico, the majority of the known taxa are restricted to the Gulf of Mexico. Of these, only two, *Cinctura hunteria* and its subspecies *C. hunteria apalachee* (described in the next section), are found in shallow water intertidal depths. All the other taxa live in deeper water, offshore areas (in 20-400 m depths), and are primarily collected by the dredging operations of commercial shrimp and scallop fishermen or from deep water lobster and crab traps. The taxonomy and systematics of this iconic and characteristic Carolinian Province genus are still in flux, with a plethora of misinformation and incorrect range data existing in the current literature. These erroneous data have led to a large amount of confusion concerning species identities and their biogeographical and bathymetric ranges within the Carolinian Province. These errors will be discussed and corrected, individually, in the sections dealing with each species or subspecies. The holotypes of the four new subspecies are deposited in the type collection of the Department of Malacology, Los Angeles County Museum of Natural History, Los Angeles, California and bear LACM catalog numbers.

ISSN 0738-9388

SYSTEMATICS

Class Gastropoda
Subclass Sorbeoconcha
Order Prosobranchia
Infraorder Neogastropoda
Superfamily Buccinoidea
Family Fasciolariidae
Subfamily Fasciolariinae
Genus *Cinctura* Hollister, 1957

Diagnosis of *Cinctura.* Originally described as a subgenus of *Fasciolaria* but here elevated to full genus status. (From Hollister, 1957: 76) "Type species: *Pyrula hunteria* G. Perry, 1811. Recent from Cape Hatteras southward to Florida and westward to Mobile Bay. Shell of medium size, fusiform, the whorls convex, the spire extended. Suture simple. A prominent spiral ridge emerges from the aperture in front of the suture and extends across the parietal wall to the margin of the callus. This subgenus differs from *Fasciolaria s.s.* in that the latter has no pre-sutural rib on the parietal wall." Hollister created the name "*Cinctura*" in reference to the cord (*cinctus*) being present along the posterior (anal) end of the aperture (*urus*). The original descriptions of *C. hunteria* and *C. lilium*, along with the synonymy of *C. distans* with *C. hunteria*, were also given by Hollister, 1957 and will not duplicated here.

Of all the diagnostic features that are used to differentiate the various living and fossil *Cinctura* species, the form of the sculpture on the early postnuclear whorls is the most important. Based on the shape and strength of this early whorl sculpture, we here recognize two species groups within the genus *Cinctura* (*sensu stricto*); the ***Cinctura hunteria*** **Complex**, with smooth, unsculptured early whorls (containing the living *C. hunteria* and *C. hunteria apalachee*), and the ***Cinctura lilium*** **Complex**, with heavily-sculptured, knobby early whorls (containing the living *C. lilium*, *C. lilium connori*, *C. keatonorum*, *C. tortugana*, and *T. tortugana tracieae*). A third species group, the ***Cinctura branhamae*** **Complex**, typified by *C. branhamae* and its subspecies *C. branhamae morganae*, is here recognized as constituting a new subgenus, *Cinctura (Hollisteria)*, which exhibits early whorl sculpture made up of strong, closely-packed vertical ribs. This new subgenus is described later in this paper. All species within the genus, both *Cinctura s.s.* and *Cinctura (Hollisteria)*, exhibit conspicuous thin, dark brown or black bands, varying in number depending on the species. Some have as few as 5 on the body whorl while others can have as many as 14 on both the body whorl and the siphonal canal.

Cinctura (sensu stricto) - the *Cinctura hunteria* Complex

This shallow water and intertidal group contains only two living taxa; the wide-ranging *C. hunteria* and its northwestern subspecies *C. hunteria apalachee*. All members of this species group, both fossil and living, are characterized as having smooth, rounded protoconchs and smooth unsculptured early whorls, lacking the small sharply-angled knobs seen on the early whorls of members of the *C. lilium* species group. An overview of the fossil record (given at the end of this paper) demonstrates that the *Cinctura hunteria* Complex is a geologically-young group of *Cinctura* species, first appearing in the Early Pleistocene (Gelasian Age) as *C. rucksorum* (Petuch, 1994). This Gelasian ancestral species gave rise to *C. holeylandica* (Petuch, 1994) during the Calabrian Age, an undescribed *C. holeylandica* subspecies during the Ionian Age, and later an undescribed subspecies of *C. hunteria* during the Tarantian Age of the Late Pleistocene.

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Cinctura hunteria (Perry, 1811)
(Figure 2A, B, C, D, I; Figure 5F, G)

Shell Shape and Proportions. The shell is of average size for the genus, with inflated, pyriform body whorl and convex sides. The spire is proportionally low or only moderately elevated, subpyramidal in shape, with indented sutures.

Color and Color Pattern. The base color is typically cream-white or bluish-white overlaid with numerous closely-packed longitudinal stripes of bluish-brown or dark khaki-green. Some specimens have scattered bright orange bands and patches, especially along the subsutural area of the shoulders and on the parietal area of the aperture. In some populations, such as those found at Sanibel Island, Florida, the shells are lighter in color, often being a pale tan-brown or light khaki-brown. The number of dark bands on the body whorl varies from 5 to 6, with most specimens having 5 lines (as in the specimens shown here in Figure 2a-d). Occasionally, specimens will have a few finer lines intercalated between the larger bands.

Siphonal Canal Structure. Proportionally very short, truncated, and broad, the smallest and least developed siphonal canal of the entire genus; the canal is heavily ornamented with 8-10 large, prominent cords, with secondary smaller cords being present between the large primary cords at the anterior end, often resulting in as many as 12-14 cords of varying sizes being present.

Early Whorls. The early postnuclear whorls are smooth and unornamented, as seen here on Figure 2I. The protoconch is proportionally large, smooth, rounded, and dome-like.

Range. As seen on Figure 1, *C. hunteria* is the widest-ranging species in the genus, extending from Cape Hatteras, North Carolina south to the Florida Keys and then northward to St. George Island and Apalachicola Bay, Franklin County, Florida. The extensive fresh water effluent from the Apalachicola River, which empties into Apalachicola Bay, acts as an ecological barrier between *C. hunteria* and its western subspecies *C. hunteria apalachee*. *Cinctura hunteria hunteria* is also the only member of its genus that is distributed over three subprovinces of the Carolinian Province; the Georgian, Floridian, and Suwannean Subprovinces (Petuch, 2013).

Ecology. *Cinctura hunteria*, the type of the genus (Hollister, 1957: 76), prefers intertidal sand flats in quiet lagoonal water conditions, and is often associated with beds of sea grasses such as *Halodule* and *Thalassia* (Petuch and Myers, 2014: 63). In the Ten Thousand Islands of southwestern Florida, *C. hunteria* is frequently collected in tide pools on the extensive barrier reef systems built by the worm gastropod *Petaloconchus*, where it feeds on the cerithiid gastropod *Batillaria minima* (Petuch and Myers, 2014: 163).

Discussion. Hollister (1957: 79) demonstrated that the taxon "*Fasciolaria distans* Lamarck, 1822" is a synonym of *Cinctura hunteria* and is not referable to *C. lilium*, as suggested by previous workers. The biogeographical distribution of *C. hunteria* has also been in a confused state, often with completely erroneous data being published by some recent workers. An example of this incorrect information is seen in the recent book by Mallard and Robin (2017: 170), where they show the range of *C. hunteria* as extending to both sides of the Yucatan Peninsula and even to the coast of Belize and both coasts of Cuba (which are within the boundaries of the Caribbean Province). They also show the species being absent from the northeastern Gulf and from the North Carolina coast. The true range of *C. hunteria* is shown here in Figure 1.

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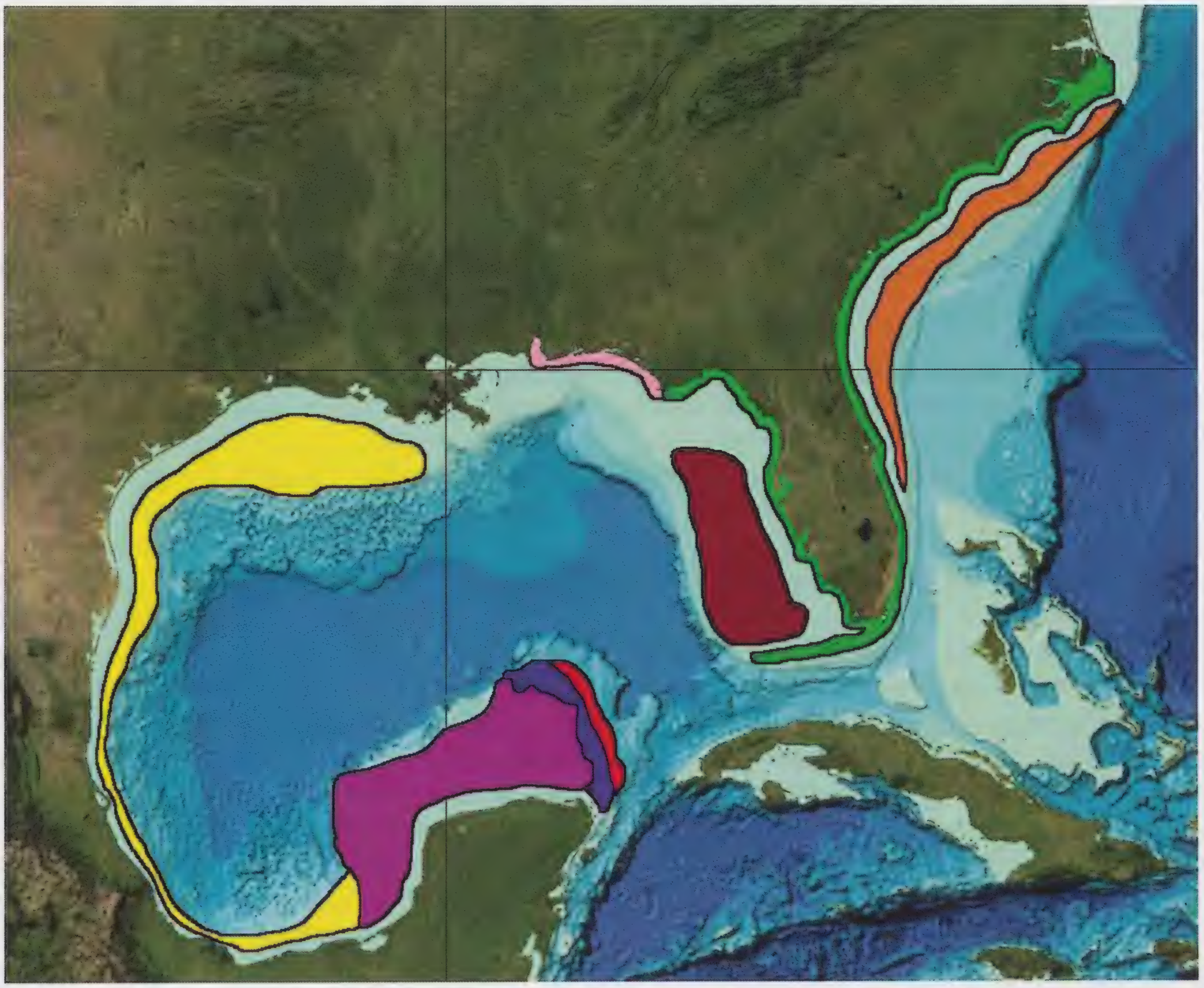

Figure 1. Map of the Gulf of Mexico and southeastern United States, showing the ranges of *Cinctura (s.s.)* and *Cinctura (Hollisteria)* species and subspecies. Green = *Cinctura hunteria;* Pink = *Cinctura hunteria apalachee;* Orange = *Cinctura keatonorum*; Burgundy = *Cinctura tortugana*; Yellow = *Cinctura lilium*; Purple = *Cinctura (Hollisteria) branhamae*; Blue = *Cinctura lilium connori*; Red = *Cinctura tortugana tracieae* and *Cinctura (Hollisteria) branhamae morganae.*

Cinctura hunteria apalachee Petuch and Berschauer, new subspecies
(Figure 2E, F, G, H, J)

Description. Shell of average size for genus and same size as nominate subspecies, stocky, with pyriform shape and very inflated body whorl; spire proportionally low, subpyramidal, with indented sutures and slightly convex sides; siphonal canal proportionally short, truncated, and broad, ornamented with 6 to 10 large, prominent cords, with few smaller secondary cords being present on some individuals; base color pale salmon-orange or cream-white, overlaid with numerous irregular, narrow, longitudinal dark orange-tan or salmon-orange elongated flammules which are best developed along subsutural area and around mid-body; base color pattern overlaid with 6 to 9 thin, prominent, regularly-spaced dark brown lines; smaller secondary lines often present between primary lines, producing pattern consisting of 9 to 14 lines on body whorl; aperture proportionally large, open, oval shaped; anterior

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end of columella with 2 large rib-like folds, with the posteriomost fold being largest in size; postnuclear and early whorls smooth and unsculptured; protoconch smooth, rounded, domelike.

Type Material. HOLOTYPE - Length 67.4 mm, width 33.1 mm, from Panama City, Florida, LACM 3803; OTHER MATERIAL EXAMINED - 3 specimens, lengths 64 mm, 67 mm, and 79 mm, from the same locality as the holotype, in the research collection of the senior author; 3 specimens, lengths 71.6 mm, 69.2 mm, and 54.2 mm, from the same locality as the holotype, in the research collection of the junior author.

Type Locality. St. Andrew Bay, Panama City, Bay County, Florida.

Range. The subspecies ranges from St. Joseph Bay and Port St. Joe, Gulf County, Florida westward to Mobile Bay, Alabama.

Ecology. The holotype and type lot were collected in shallow pools at low tide, on sand flats in a protected bay. The new subspecies prefers intertidal sand flats and sea grass beds, where it was observed feeding on small tellinid and mactrid bivalves.

Etymology. The taxon honors the Apalachee Indian Tribe of the Florida Panhandle. Once a large and powerful tribal group, only a few members survived the diseases brought by the first Spanish settlers. Their descendants now live in Louisiana.

Discussion. This previously-unrecognized subspecies of *C. hunteria* primarily differs from the nominate subspecies in having a narrower, more slender spire with distinctly less-inflated early whorls (easily seen in a comparison of Figures 1I and 1J). *Cinctura hunteria apalachee* also differs from the nominate subspecies in consistently having a much lighter shell color, being dominated by shades of salmon-orange, reddish-tan, or pale orange-tan, and lacking the dark khaki-green color seen on typical *C. hunteria hunteria*. The banding pattern is also different on the two subspecies, with the nominate subspecies typically having 5 or 6 dark bands on the body whorl and with *C. hunteria apalachee* typically having 6 to 8 dark bands, and sometimes with as many as 14.

Cinctura (sensu stricto) - the *Cinctura lilium* Complex

The members of this species group, the most species-rich of the entire genus, differ from members of the *C. hunteria* Complex in having narrower, more elongated and distinctly fusiform shells with higher spires, and with heavily-sculptured early spire whorls that are ornamented with sharply-angled small knobs. This type of knobbed spire sculpture was best developed on the mid-Pleistocene (Ionian Age) *Cinctura evergladesensis* (Petuch, 1991), from the Belle Glade Member of the Bermont Formation of southern Florida (Figure 5D). During the warm Ionian time, the southern half of the Florida Peninsula was under water, allowing *C. evergladesensis* to extend its range into the Gulf of Mexico and northward to at least North Carolina. The many populations of this heavily-knobbed species became isolated from each other during the low sea levels that occurred between the Ionian and Tarantian Ages (the Middle Pleistocene-Late Pleistocene boundary). These geographically-isolated populations evolved into the species and subspecies of the *C. lilium* Complex; with the Gulf housing four distinct taxa, *C. lilium*, *C. lilium connori*, *C. tortugana*, and *C. tortugana traciae* and with the relictual *C. keatonorum* being isolated along the Atlantic coast from North Carolina to central Florida. The presence of two distinct subspecies along the eastern edge of the Yucatan Peninsula (Yucatan Straits) demonstrates that the group is presently undergoing rapid speciation.

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Cinctura lilium (Fischer von Waldheim, 1807)
(Figure 4A, B, G; Figure 5E)

Shell Shape and Proportions. The shell is large for the genus, elongated and fusiform, with rounded spire whorls. The body whorl is moderately inflated, with rounded, convex sides. The spire is elevated and protracted, almost the same length as the body whorl. The anterior end of the columella is ornamented with two large, prominent rib-like folds, with the posteriormost fold being the largest.

Color and Color Pattern. The base color of the shell is a pale grayish-white or salmon-gray overlaid with numerous irregular, narrow, longitudinal dark gray or dark orange-tan elongated flammules. The flammules are best developed along the subsutural area and around the mid-body. This base color pattern is overlaid with 8-10 thin, prominent, regularly-spaced thin dark brown bands, with 2 or 3 bands extending onto the siphonal canal. In some specimens, thin, less-developed secondary lines are sometimes present between the primary lines. The parietal area characteristically has a white glaze.

Siphonal Canal Structure. The siphonal canal is proportionally very long and narrow, being wider at the juncture with the body whorl and tapering to the anterior tip. The canal is ornamented with 7 or 8 large low cords with 2-3 very fine threads being present between each pair of large cords. The anteriormost siphonal cords are generally smaller and less developed than the posterior cords.

Early Whorls. The postnuclear whorls are ornamented with 7 to 9 large rounded knobs, with the larger knobs being distinctly angled. The sloping subsutural area that is posterior to the postnuclear knobs are ornamented with 3 large cords.

Range. As seen on Figure 1, *Cinctura lilium* has the second-largest biogeographical range of the genus, ranging from the western side of the Mississippi River Delta south to off the coast of Tabasco State, Mexico. This species is confined to the Texan Subprovince of the Carolinian Province (Mississippi River Mouth south to Veracruz, Mexico; see Petuch, 2013), and is considered to be a primary subprovincial index species.

Ecology. Found on muddy sand sea floors in depths ranging from 4 m to 46 m (Tunnell *et al.*, 2010: 220), but most commonly collected in depths of around 25 m.

Discussion. The lectotype of *C. lilium*, designated by Hollister and illustrated in his 1957 paper (plate 6, figure 1), was collected in the Bay of Campeche (designated type locality), probably off Veracruz, Mexico. The lectotype is an 82 mm specimen, very similar to the shell shown here on Figure 5E and is deposited in the British Museum (Natural History) under the Sloane Catalog number 1481. Hollister's lectotype, however, has a damaged siphonal canal, with the entire anterior end broken off. The complete specimen would have had a proportionally longer siphonal canal, similar to the specimens shown here on our Figures 4 and 5. *Cinctura lilium* is the only member of its genus to exhibit large variations in the length and development of the siphonal canal, often from within the same population. Juveniles and smaller specimens have proportionally shorter siphonal canals, similar in length to those seen on *C. keatonorum* and *C. tortugana* (as in the specimen shown in Figure 5E). Full adult and large specimens will often have proportionally longer siphonal canals (as seen here on Figure 4A, B), approximating the long, narrow canal seen on *C. (Hollisteria) branhamae* (Figure 4E, F). Indeed, the elongated siphonal canal on older adults has led some workers (Tunnell, *et al.*, 2010: 220) to misidentify specimens of Texas *C. lilium* as *C. (Hollisteria) branhamae*, a species now known to be confined to the Campeche Bank and Yucatan Peninsula and not found off Texas (discussed later in this paper). Mallard and Robin (2017: 171, figure 1) show a

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classic *C. lilium* but give no detailed locality data for the specimen ("Gulf of Mexico").

Cinctura lilium connori Petuch and Berschauer, new subspecies
(Figure 4C, D, H)

Description. Shell of average size for genus, elongated, with rounded whorls and sloping shoulders; spire elevated, protracted, more than two-thirds total body length; siphonal canal proportionally long, well-developed, with only a slight stricture at the body whorl-siphonal canal juncture; shell color pale orange-white or salmon overlaid with numerous irregular, narrow, longitudinal dark orange-tan or orange-red flammules; longitudinal flammules best developed along subsutural area and around mid-body; flammule pattern overlaid with 8-12 thin, regularly-spaced dark brown lines; thinner and less-developed secondary lines frequently present between pairs of primary lines; siphonal canal dark orange or orange-tan with 1-4 dark brown thin lines, ornamented with 4-7 raised spiral cords; aperture proportionally small, oval in shape; early post-nuclear whorls of spire heavily sculptured with 14-16 large, sharply angles knobs (Figure 4H).

Type Material. HOLOTYPE - length 72.5 mm, width 31.4 mm, 250 m depth off Cabo Catoche, Mexico, LACM 3804; OTHER MATERIAL EXAMINED - length 91 mm, width 47 mm, from the same depth and locality as the holotype, in the research collection of the senior author.

Type Locality. Trawled by deep water prawn (*Glyphograngon*) fishermen from 250 m depth in the Yucatan Channel, off Cabo Catoche, Quintana Roo, Mexico.

Range. As shown on Figure 1, *Cinctura lilium connori* is confined to the eastern side of the Campeche Escarpment, along the Yucatan Channel.

Ecology. The new subspecies lives in deep water areas along the upper edge of the bathyal zone, ranging from 100 to 250 m depths. This deep neritic-upper bathyal bathymetric preference differs dramatically from that of the nominate subspecies, *C. lilium lilium*, which prefers depths of only around 25 to 40 m.

Etymology. Named for Connor Johnson, Wilmington, North Carolina; son of Mark Johnson, who kindly donated the holotype to our research project.

Discussion. This new eastern Yucatan subspecies of the Texan Subprovince *C. lilium* represents an isolated population of the nominate subspecies that has become cut-off from the main eastern Mexican population, probably during the extreme sea level drop at the end of the Late Pleistocene. Since that time, genetic isolation and genetic drift have allowed this eastern population to evolve distinctive shell characters that readily separate it from *C. lilium lilium* in the western Gulf of Mexico. As can be seen in Figure 4c-d, the new subspecies has a much more elongated and fusiform shell than does the nominate subspecies, with a more slender and less-inflated body whorl. It is also a much more colorful shell, exhibiting shades of bright red and dark orange. The principal difference between the two subspecies is seen in the structure and development of the knobbed sculpture on the early whorls. In *C. lilium lilium*, the spire knobs are proportionally smaller and have more sloping and rounded edges (Figure 4G), while the spire knobs of *C. lilium connori* are proportionally larger, fewer in number, and have sharper and more angled edges (Figure 4H).

Cinctura keatonorum Petuch, 2014
(Figure 3A, B, H)

Shell Shape and Proportions. The shell is of average size for genus, elongated and fusiform, with rounded whorls and a distinctly sloping shoulder. The body whorl is moderately inflated, with rounded, convex sides. The spire is

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elevated and protracted, almost the same length as the body whorl. The anterior end of the columella is ornamented with two large, prominent rib-like folds, with the posteriormost fold being the largest.

Color and Color Pattern. The base color of the shell is a pale salmon-orange overlaid with numerous irregular, narrow, longitudinal dark orange-tan or salmon-orange elongated flammules. The flammules are best developed along the subsutural area and around the mid-body. This base color pattern is overlaid with 6 thin, prominent, regularly-spaced dark brown lines. Thin, less-developed secondary lines are sometimes present between the primary lines, especially along the anterior end of the body whorl (as in the specimen shown here in Figure 3). The parietal area characteristically has a bright orange-tan glaze.

Siphonal Canal Structure. The siphonal is proportionally short, wide, and truncated, with a solid orange-tan color, with 7 large raised cords. The anteriormost siphonal cords are generally smaller than the posterior cords.

Early Whorls. The postnuclear whorls are ornamented with 5-6 deeply incised spiral sulci and 6-8 low, poorly-developed, undulating, rib-like knobs, which are often suppressed by the prominent spiral grooves.

Range. As shown in Figure 1, *C. keatonorum* ranges from offshore of Cape Hatteras, North Carolina, southward to near Fort Pierce, St. Lucie County, Florida.

Ecology. *Cinctura keatonorum* lives in depths of 30-50 m in offshore areas on shell hash and coarse sand, where it is most often associated with the immense shoal-like beds of the large endemic Georgian Subprovince scallop *Argopecten gibbus carolinensis*. Since this endemic subspecies is the source of a large commercial scallop fishery, *C. keatonorum* is most often collected as a by-catch of scallop dredging.

Discussion. The senior author originally described this offshore Georgian Subprovince species as a bathymetric subspecies of the shallow water *Cinctura hunteria* (Petuch, 2013: 203-204). The deeper water *Cinctura keatonorum* also differs from the shallow water *C. hunteria* in being a larger and more elongated shell with a proportionally much higher and more protracted spire, in having a distinctive orange-salmon shell color, and in having heavily-sculptured grooved early whorls instead of the smooth postnuclear whorls seen on *C. hunteria*. Because of these differences, we now consider *C. keatonorum* to be a full species all to itself and also to be a member of the *C. lilium* Complex, and not closely-related to *C. hunteria*. Richards (1962: plate 20, figure 6) illustrates a fossil specimen of *C. keatonorum* from the Pamlico Formation at Beaufort, North Carolina, but misidentifies it as "*Fasciolaria distans* Lamarck" (now known to be a synonym of the shallow water *C. hunteria*). This fossil specimen demonstrates that *C. keatonorum* was the only *Cinctura* species living in North Carolina during the cold late Pleistocene time and that the warmer-water *C. hunteria* moved into that area only when sea temperatures rose during the latest Pleistocene and Holocene. The deeper water *C. keatonorum* can then be seen to be an isolated Pleistocene relict of the *C. lilium* Complex that has found a refuge in the East Coast offshore scallop beds.

Cinctura tortugana (Hollister, 1957)
(Figure 3C, D, G)

Shell Shape and Proportions. The shell is of average size for genus, elongated and fusiform, with rounded whorls and a distinctly sloping shoulder. The body whorl is moderately inflated, with rounded, convex sides. The spire is elevated and protracted, almost the same length as the body whorl. The anterior end of the columella is ornamented with two large,

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prominent rib-like folds, with the posteriormost fold being the largest.

Color and Color Pattern. The base color of the shell is a pale salmon-orange overlaid with numerous irregular, narrow, longitudinal dark orange-tan or salmon-orange elongated flammules. The flammules are best developed along the subsutural area and around the mid-body. This base color pattern is overlaid with 6 thin, prominent, regularly-spaced dark brown lines. Thin, less-developed secondary lines are sometimes present between the primary lines, especially along the anterior end of the body whorl (as in the specimen shown here in Figure 3). The parietal area characteristically has a bright orange-tan glaze.

Siphonal Canal Structure. The siphonal is proportionally short, wide, and truncated, with a solid orange-tan color, with 7 large raised cords. The anteriormost siphonal cords are generally smaller than the posterior cords.

Early Whorls. The postnuclear whorls are ornamented with 5-6 deeply incised spiral sulci and 6-8 low, poorly-developed, undulating, rib-like knobs, which are often suppressed by the prominent spiral grooves.

Range. As can be seen on Figure 1, *Cinctura tortugana* is found in deeper, offshore areas along western and southwestern Florida, from north of the Dry Tortugas, Florida Keys (type locality) northward to off Cedar Key, Levy County, Florida. *Cinctura tortugana* is confined to the southern part of the Suwannean Subprovince of the Carolinian Province (Petuch, 2013).

Ecology. *Cinctura tortugana* lives on carbonate rubble sea floors on the West Florida Shelf and along the edge of the bathyal zone, in depths of 50 to 200 m. In the deeper areas along the edge of the Florida Escarpment, *C. tortugana* is associated with sea floors that are dominated by the red coralline algae *Porolithon* and *Goniolithon*, which form thick and densely-intertwined beds composed of algal nodules (rhodoliths). Here, it occurs along with other distinctive rhodolith-associated mollusks such as the muricid *Chicoreus rachelcarsonae* Petuch, 1987, the cone shell *Dauciconus aureonimbosus* (Petuch, 1987), the busyconid *Lindafulgur lyonsi* (Petuch, 1987), and the scallop *Lindapecten lindae* Petuch, 1995.

Discussion. This impressive and colorful species was originally described as a subspecies of *Cinctura lilium* (Hollister, 1857: 79-80), with the type locality being from "Off the Dry Tortugas, to the northwest" (now known as the "Tortugas Shrimping Ground"). Besides being isolated from each other on either side of the Gulf of Mexico, the Suwannean Subprovince *C. tortugana* differs from the Texan Subprovince *C. lilium* in being a smaller, more slender species with a much shorter and less developed siphonal canal and also in being a much more colorful shell, ornamented with conspicuous bright orange or orange-red flammules. The early whorl structure of the Texan and eastern Mexico *C. lilium* also differs from that of the western Florida *C. tortugana* in having larger, more prominent, and better developed angled knobs on the early postnuclear whorls (seen here in a comparison of Figures 3G and 4G). Because of these differences in shell morphology and biogeography, we here consider *C. tortugana* to be a full species unto itself. Mallard and Robin (2017: 171, figures 2 and 3) show two specimens of the classic *C. tortugana* but only give their collection localities as "Gulf of Mexico" and "Florida, USA". The actual biogeographical distribution of *C. tortugana* is shown here in Figure 1.

Cinctura tortugana traciae Petuch and Berschauer, new subspecies
(Figure 3E, F, I)

Description. Shell is of average size for genus, thickened and heavy, elongated and fusiform, with rounded whorls and distinctly sloping

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subsutural area; body whorl moderately inflated, with slightly rounded sides; spire elevated and protracted, almost same length as body whorl; The anterior end of columella ornamented with two large, prominent rib-like folds, with posteriormost fold being largest; shell base color pale salmon-orange or cream-white overlaid with numerous irregular, narrow, longitudinal bright blood red flammules which are best developed along subsutural area and around mid-body; often fusing into nearly solid blood red bands; red color pattern overlaid with 7 thin, prominent, regularly-spaced dark brown lines; thin, less-developed secondary lines sometimes present between pairs of primary lines, especially along anterior end of body whorl (as shown here in Figure 3E); siphonal canal proportionally short, narrow, with dark reddish-brown anterior tip, ornamented with 7 large raised cords; anteriormost siphonal cords are generally smaller than posterior cords; postnuclear whorls ornamented with 5-6 deeply incised spiral sulci and 8-10 proportionally large, well-developed, sharply-angled knobs.

Type Material. HOLOTYPE - Length 72.3 mm, width 31.5 mm, off Cabo Catoche, Mexico, LACM 3805; OTHER MATERIAL EXAMINED - length 73 mm, width 31 mm, from the same locality and depth as the holotype, in the research collection of the senior author.

Type Locality. Trawled by deep water prawn (*Glyphograngon*) fishermen from 250 m depth in the Yucatan Channel, off Cabo Catoche, Quintana Roo, Mexico.

Range. As seen in Figure 1, this new subspecies is confined to the eastern side of the Campeche Escarpment, along the Yucatan Channel.

Ecology. The new subspecies lives in deep water areas along the lower neritic and upper bathyal zones, ranging from 200 to 300 m depths. This deep neritic-upper bathyal bathymetric preference differs dramatically from that of the nominate subspecies, *C. tortugana tortugana*, which prefers shallower depths of 50 to 200 m in the lower neritic zone.

Etymology. Named for Traci Kelley Johnson, Wilmington, North Carolina; wife of Mark Johnson, who kindly donated the holotype to our research project.

Discussion. This new isolated deep water eastern Yucatan subspecies differs from the western Florida nominate subspecies in being a smaller, heavier, and more slender shell with a less inflated body whorl and narrower spire whorls. *Cinctura tortugana traciae* is also a much more colorful shell, usually exhibiting bright blood-red flammules and wide broken red bands as opposed to the orange and pale reddish-orange flammules seen on *C. tortugana tortugana*. The primary difference between the two subspecies is seen in the structure of the early whorls. In *C. tortugana tortugana*, the postnuclear whorls are low and rounded (Figure 3G) while those of *C. tortugana traciae* are large, prominent, and sharply-angled (Figure 3I). Mallard and Robin (2017: 171, figure 4) show a specimen of *C. tortugana traciae* from Cabo Catoche, but misidentify it as a "*C. lilium*".

During the major sea level drop in the Middle Pleistocene (Calabrian-Ionian Age Boundary), which may have been as extreme as 200 m below the present sea level, the eastern edge of the Campeche Escarpment (off the eastern side of the Campeche Bank) and the western edge of the Florida Escarpment (off the western edge of the West Florida Shelf) would have been separated by only 80 km. During this time of extremely low sea levels and much shallower water than is seen today, the ancestor of *C. tortugana* would have been able to colonize both sides of the area north of the Yucatan Channel. When sea level rose at the end of the Pleistocene, this ancestral species would have been bisected into two geographically-isolated populations, one along the eastern edge of the Campeche Bank and one off southwestern

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Florida. During the Tarantian Age of the Late Pleistocene, these two isolated populations evolved into *C. tortugana* in Florida and *C. tortugana traciae* in Mexico.

Cinctura (Hollisteria) - the *Cinctura branhamae* Complex

Because of the unique shell characters and geographical isolation of this group, we here propose a new subgenus for *C. branhamae* and its new subspecies, *C. branhamae morganae*.

Family Fasciolariidae
Subfamily Fasciolariinae
Genus *Cinctura* Hollister, 1957
Subgenus *Hollisteria* Petuch and Berschauer, new subgenus

Diagnosis. Shells large for genus, thin and delicate, very elongated and fusiform, with elevated, protracted spires and long, narrow siphonal canals; shoulder rounded and spire whorls convex; body whorl inflated and subglobose; postnuclear and early whorls sculpted with numerous small, thin, closely-packed vertical ribs, which are, in turn, overlaid with 6 strong spiral threads; constriction at body whorl-siphonal canal juncture very deep and abrupt; pre-sutural parietal cord proportionally very small, thin, and poorly-developed.

Type Species. *Cinctura branhamae* (Rehder and Abbott, 1951) (originally *Fasciolaria distans branhamae*), from deep water off the Yucatan Peninsula of Mexico.

Species in *Hollisteria*. Only two taxa are presently referable to the new subgenus; *Cinctura (Hollisteria) branhamae* (Rehder and Abbott, 1951) and *Cinctura (Hollisteria) branhamae morganae* Petuch and Berschauer, n. subsp.

Range. The subgenus *Hollisteria* is known only from the eastern Bay of Campeche, the Campeche Bank, and the Yucatan Escarpment of the Yucatan Peninsula of Mexico.

Etymology. The new subgenus is named in honor of Solomon Cady Hollister, renowned structural engineer and university professor and also the Dean of the College of Engineering at Cornell University (1937 to 1959). In his spare time, Professor Hollister also collected and studied living and fossil mollusks, mostly those from southern Florida and the Gulf of Mexico. His research resulted in papers on the living fasciolariids, the living and fossil busyconids, and on Florida fossil vase shells. He was also the author of several new genera, including *Cinctura*.

Discussion. This group of thin, fragile, and very elongated deep water *Cinctura* taxa is restricted to the Yucatan Peninsula of Mexico and shows no relationship to any other group of Banded Tulips found elsewhere in the Carolinian Province, living or fossil. The distinctive early whorl sculpture of this group, consisting of small, sharply-defined vertical ribs, is unique within the genus *Cinctura* and indicates that *Hollisteria* evolved as a local endemic radiation that has always been confined to the Campeche Banks. Unlike the other species groups within the genus *Cinctura*, the pre-sutural cord along the posterior end of the parietal region is greatly reduced, being only a faint, thin, blade-like cord.

Cinctura (Hollisteria) branhamae
(Rehder and Abbott, 1951)
(Figure 4E, F, I)

Shell Shape and Proportions. The shell is the largest in the genus, and is thin and fragile with a distinctive elongated, slender, and fusiform shape. The body whorl is inflated and the spire is highly elevated, almost equal in length to the body whorl. The constriction at the body whorl-siphonal canal juncture is very well developed. The aperture is proportionally very wide and open, oval in shape.

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Color and Color Pattern: *Cinctura (Hollisteria) branhamae* is generally a pale salmon-orange color with scattered thin, longitudinal, slightly darker salmon-orange flammules. This base color is overlaid with 10 or 11 evenly-spaced, thin dark brown bands. The siphonal canal is colored a darker orange or orange-tan.

Siphonal Canal Structure. The siphonal canal is proportionally very long and narrow, almost tubular in shape. This Campeche Bank endemic species has the longest and best-developed siphonal canal of the entire genus *Cinctura*.

Early Whorls. The protoconch is proportionally large and rounded. The postnuclear and early whorls are ornamented with numerous small, thin, closely-packed vertical ribs, which are, in turn, overlaid with 6 strong spiral threads.

Range. As can be seen in Figure 1, *Cinctura (Hollisteria) branhamae* is found all across the wide Campeche Bank off northern Yucatan, from Tabasco State to Quintana Roo State, and northward to the Arcas Cays and Alacran Reefs along the Yucatan Escarpment adjacent to the Mexico Basin.

Ecology. This large and conspicuous Campeche Bank species prefers carbonate mud sea floors in depths ranging from 50 to 150 m. There, it is associated with other classic Yucatan endemic gastropods such as the cone shell *Gradiconus sennottorum* (Rehder and Abbott, 1951), the volute *Scaphella junonia butleri* Clench, 1953, the busyconids *Lindafulgur candelabrum* (Lamarck, 1816) and *Busycoarctum coarctatum* (Sowerby I, 1825), and the muricid *Vokesimurex sallasi* (Rehder and Abbott, 1951).

Discussion. This large and characteristic Yucatan gastropod was originally described as "*Fasciolaria distans branhamae"* by Rehder and Abbott (1951), but is here considered to be a full species, distinct from "*F. distans*" (which is now considered to be a synonym of *Cinctura hunteria*, as discussed earlier in this paper). In their recent book on the Fasciolariidae, Mallard and Robin (2017: 169) show a typical specimen of *C. (Hollisteria) branhamae* from off Campeche but also illustrate two specimens of *C. tortugana* ("Gulf of Mexico") on the same figure. Although they considered all three shells to be conspecific, the two illustrated *C. tortugana* have noticeably short siphonal canals that are not even close to the length of the siphonal canal of the illustrated *C. (Hollisteria) branhamae*. They also lack the inflated body whorl and conspicuous constriction at the body whorl-siphonal canal juncture that typifies true *C. (Hollisteria) branhamae*.

Cinctura (Hollisteria) branhamae morganae
Petuch and Berschauer, new subspecies
(Figure 5A, B, C)

Description. Shell large for genus but small for subgenus *Hollisteria*, thin and fragile, elongated, fusiform, with high protracted spire; constriction at body whorl-siphonal canal juncture very well developed, producing proportionally long, narrow siphonal canal; base shell color dark salmon-orange or pale lavender-tan with darker salmon-tan or brownish-purple elongated longitudinal flammules; base color overlaid with 12-15 thin, evenly-spaced, dark brown bands; occasional specimens with thin brown bands extending onto siphonal canal; specimens may also have finer secondary brown bands present between pairs of larger bands; aperture proportionally large, oval in shape; pre-sutural parietal cord poorly developed, thin and blade-like; 2 folds at anterior end of columella equal in size, proportionally large and prominent; postnuclear and early whorls sculpted with numerous prominent, thin, closely-packed vertical ribs, which are, in turn, overlaid with 6 strong spiral threads; constriction at body whorl-siphonal canal juncture very deep and abrupt; pre-sutural

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parietal cord proportionally very small, thin, and poorly-developed.

Type Material. HOLOTYPE - Length 71.2 mm, width 30.5 mm, off Cabo Catoche, Quintana Roo, Mexico, LACM 3806; OTHER MATERIAL EXAMINED - length 103 mm, width 42 mm, from the same locality and depth as the holotype, in the research collection of the senior author.

Type Locality. Trawled by deep water prawn (*Glyphograngon*) fishermen from 250 m depth in the Yucatan Channel, off Cabo Catoche, Quintana Roo, Mexico.

Range. As seen in Figure 1, *Cinctura (Hollisteria) branhamae morganae* is confined to deep water along the eastern side of the Campeche Escarpment, bordering the Yucatan Channel.

Ecology. The new subspecies lives in deep water areas along the lower neritic and upper bathyal zones, preferring depths of 200 to 300 m. There, the new subspecies lives on a carbonate mud and shell hash sea floor and is associated with two other deep water *Cinctura* subspecies, *C. lilium connori* and *C. tortugana traciae*, along with the large volutes *Aurinia macginnorum* (Garcia and Emerson, 1987) and *Caricellopsis contoyensis* (Emerson, 1979). The deep neritic-upper bathyal bathymetric preference of *C. (Hollisteria) branhamae morganae* differs dramatically from that of the nominate subspecies, *C. (Hollisteria) branhamae branhamae*, which prefers depths of 50-150 m in the lower neritic zone of the main Campeche Banks.

Etymology. Named for Morgan Taylor Berschauer, Laguna Hills, California, daughter of the junior author, an inspired natural historian and professional photographer.

Discussion. This new deep water subspecies from the eastern Yucatan Escarpment differs from the shallower water Campeche Bank nominate subspecies in being a smaller, less elongated shell with a noticeably lower and less protracted spire. *Cinctura (Hollisteria) branhamae morganae* also differs from *C. (Hollisteria) branhamae branhamae* in being a more darkly-colored shell, with darker salmon-tan or brownish-purple flammules, and in having more numerous and proportionally wider dark spiral bands. The nominate subspecies has 10 or 11 dark spiral bands on the body whorl, while the new subspecies generally has between 12 and 15 bands on the body whorl. Some specimens of *C. (Hollisteria) branhamae morganae* also have fine secondary bands present between pairs of primary bands and also fine bands on the siphonal canal.

Fossil Record and Evolutionary History

The genus *Cinctura* first appears in the Buckingham Member of the Tamiami Formation of southern Florida, during the early Piacenzian Age of the Pliocene Epoch, around 4.2 million years BP. There, it is represented by a rare, elongated unnamed species that is a member of the *C. lilium* Complex. The genus began to diversify during the late Piacenzian Pliocene, evolving at least three more species. The peak evolutionary development of the genus took place during the Early and Middle Pleistocene Epoch, when an additional seven species appeared in the fossil record. This last evolutionary radiation was the ancestor of the species complexes seen in the modern Carolinian Province. For illustrations and descriptions of the fossil *Cinctura* taxa listed here, see Petuch, 1994 and 2004; Richards, 1962; and Ward and Blackwelder, 1987. The known fossil *Cinctura* species are listed here by geochronology.

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Late Pliocene (Piacenzian Age) - 3.6 to 2.58 mya

Tamiami Formation, Buckingham Member (Southern Florida)

Cinctura unnamed species (highly elongated shell and short siphonal canal) (*C. lilium* Complex)

Tamiami Formation, Pinecrest Member (Southern Florida)

Cinctura rhomboidea (Rogers, 1839) (also the **Yorktown Formation** of Virginia and North Carolina, the **Duplin Formation** of North and South Carolina, and the **Jackson Bluff Formation** of northern Florida and the Florida Panhandle (*Cinctura lilium* Complex)

Tamiami Formation, Fruitville Member (Unit 4) (Southern Florida)

Cinctura sarasotaensis (Petuch, 1994) (*C. lilium* Complex)

Chowan River Formation (Virginia and North Carolina)

Cinctura beaufortensis (Ward and Blackwelder, 1987) (*C. lilium* Complex)

Early Pleistocene (Gelasian Age) - 2.58 to 1.8 mya

Caloosahatchee Formation, Fort Denaud Member (Southern Florida)

Cinctura apicina (Dall, 1890) (*C. lilium* Complex)

Caloosahatchee Formation, Ayers Landing Member (Southern Florida)

Cinctura lindae (Petuch, 1994) (*C. lilium* Complex)

Nashua Formation, Rucks Pit Member (Southern Florida)

Cinctura rucksorum (Petuch, 1994) (*C. hunteria* Complex)

Early Middle Pleistocene (Calabrian Age) - 1.8 mya to 780,000 BP

Bermont Formation, Holey Land Member (Southern Florida)

Cinctura capelettii (Petuch, 1994) (*C. lilium* Complex)

Cinctura holeylandica (Petuch, 1994) (*C. hunteria* Complex)

Late Middle Pleistocene (Ionian Age) - 780,000 to 126,000 BP

Bermont Formation, Belle Glade Member (Southern Florida)

Cinctura evergladesensis (Petuch, 1991) (Figure 5E; *C. lilium* Complex)

Cinctura holeylandica subspecies (*C. hunteria* Complex)

Late Pleistocene (Tarantian Age) - 126,000 to 11,700 BP

Fort Thompson Formation, Coffee Mill Hammock Member (Southern Florida)

Cinctura hunteria subspecies (*C. hunteria* Complex)

Pamlico Formation (North Carolina)

Cinctura keatonorum Petuch, 2013 (*C. lilium* Complex; illustrated in Richards, 1962)

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ACKNOWLEDGMENTS

We thank the following for their help in acquiring specimens of the Banded Tulips used in this paper, for their generous donation of study specimens, and for their help in field collecting. Mark Johnson, Wilmington, North Carolina, for the type specimens of *Cinctura lilium connori* and *Cinctura tortugana traciae* ; A. Kenneth ("Kenny") Brown, Jr., Chokoloskee, Florida; Lyle Therriault, Concord, North Carolina; Robert Owens, Boca Raton, Florida; Morris ("Andy") Foster, Jupiter, Florida; Robert L. Eason, Paris, Tennessee; Capt. Craig Daniels, Chokoloskee, Florida; Michael Bruggeman, Snellville, Georgia; Brian Ward, Jupiter, Florida; Patrick Wilson, Lake Worth, Florida; Ida Bucheck, West Palm Beach, Florida.

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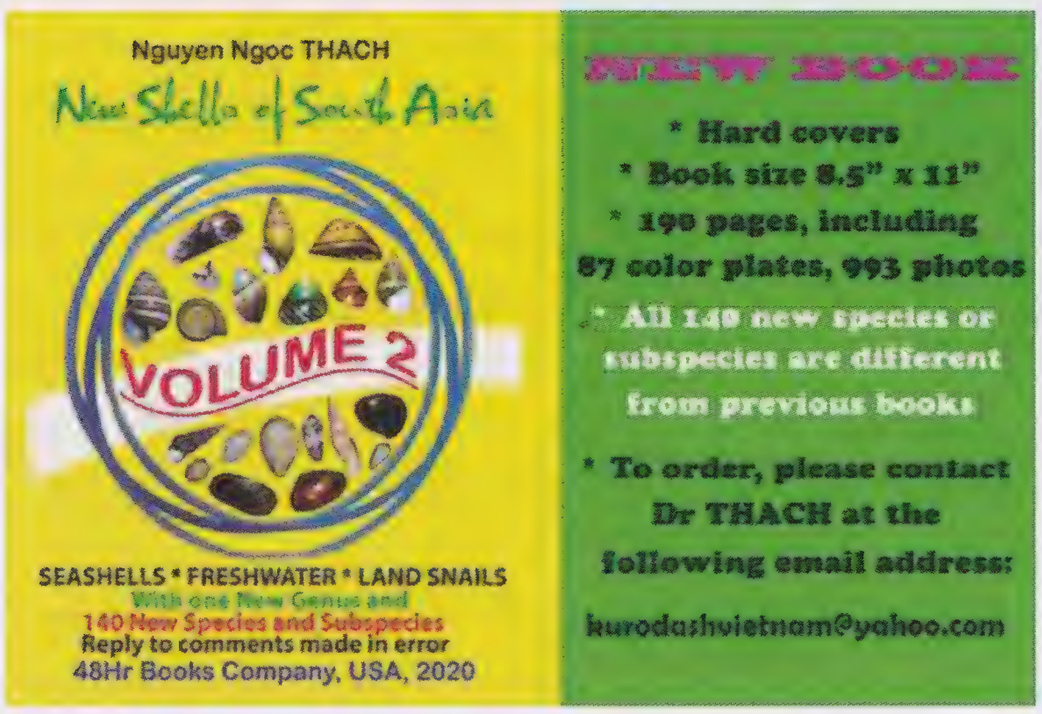

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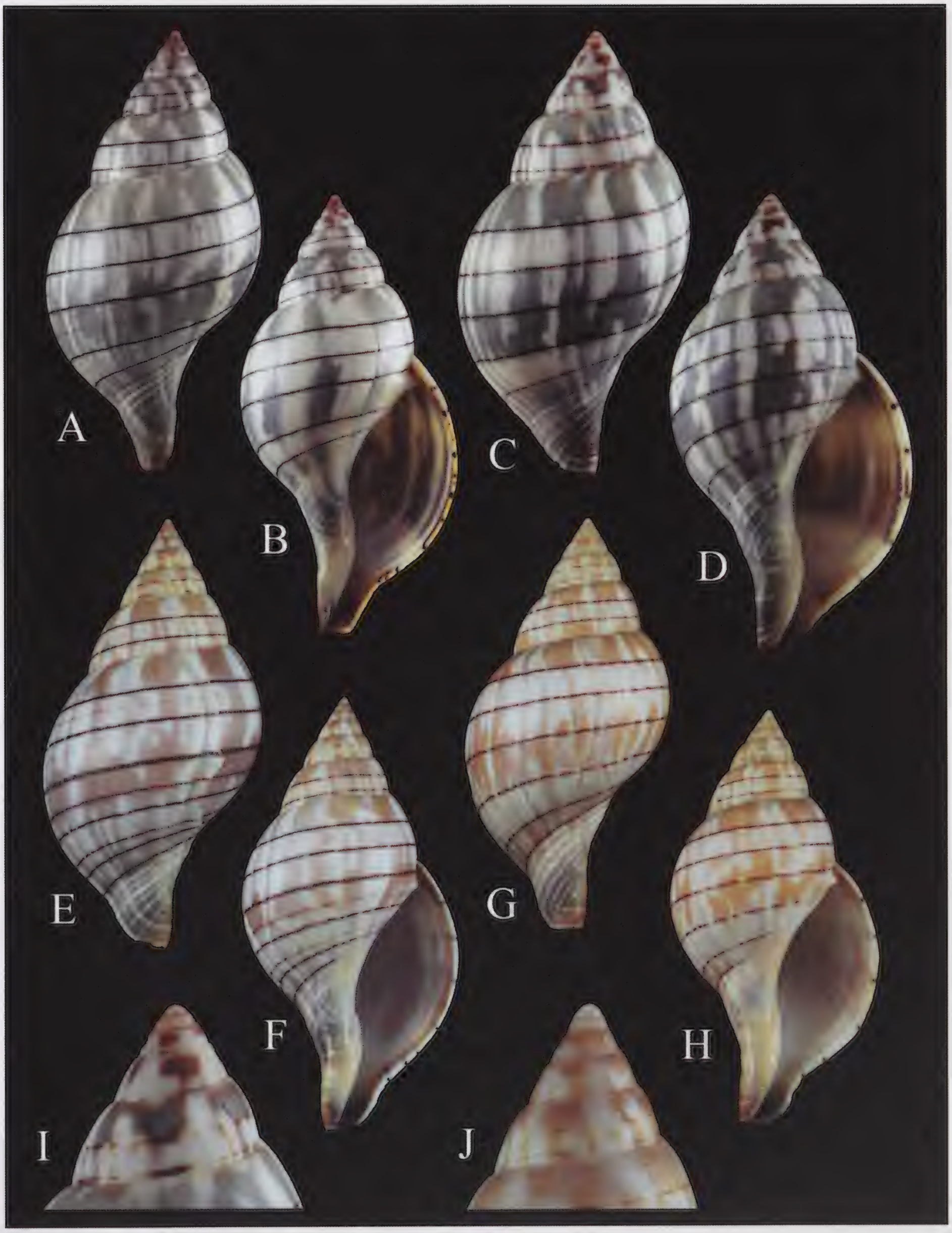

Figure 2. Members of the *Cinctura hunteria* Species Complex.
A, B= *Cinctura hunteria* (Perry, 1811), length 78 mm, collected in a tide pool on a vermitid gastropod reef off Turtle Key, Ten Thousand Islands, Collier County, Florida. Petuch collection; **C, D**= *Cinctura hunteria* (Perry, 1811), length 62.4 mm, Rabbit Key, Ten Thousand Islands, Collier County, Florida, Berschauer collection; **E, F**= *Cinctura hunteria apalachee* Petuch and Berschauer, new subspecies, holotype, length 67.4 mm, LACM 3803, low tide on sand flats, St. Andrew Bay, Panama City, Bay County, Florida; **G, H**= *Cinctura hunteria apalachee* Petuch and Berschauer, new subspecies, length 64 mm, low tide on sand flats, St. Andrew Bay, Panama City, Bay County, Florida. Petuch collection; **I**= *Cinctura hunteria*, close-up of the protoconch and early whorls; **J**= *Cinctura hunteria apalachee*, close-up of the protoconch and early whorls.

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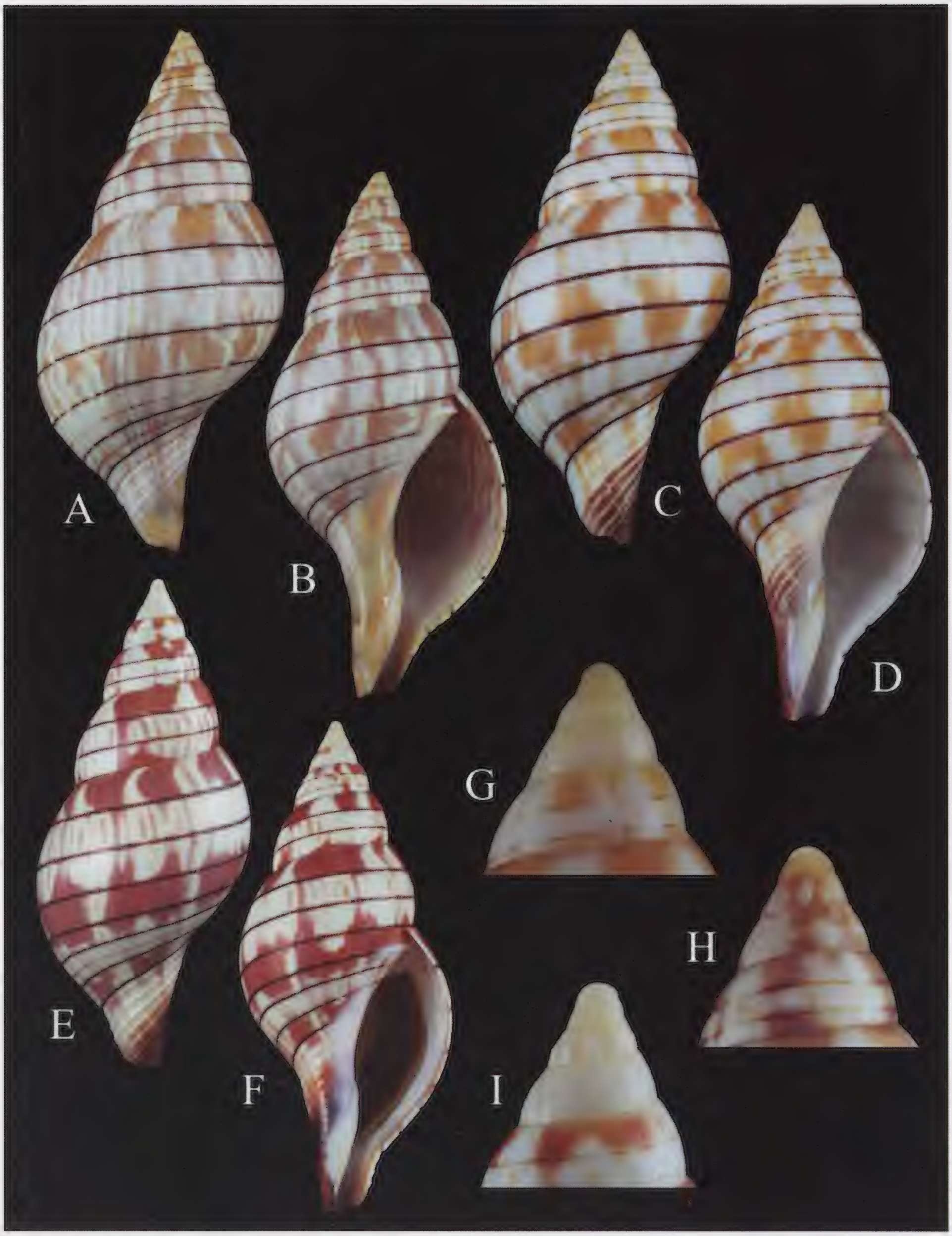

Figure 3. Members of the *Cinctura lilium* Species Complex.
A, B= *Cinctura keatonorum* Petuch, 2014, length 92 mm, 50 m depth off Cape Canaveral, Brevard County, Florida, from commercial scallop boats. Petuch collection; **C, D=** *Cinctura tortugana* (Hollister, 1957), length 74 mm, 60 m depth north of the Dry Tortugas, Monroe County, Florida, in a deep water lobster trap. Petuch collection; **E, F=** *Cinctura tortugana traciae* Petuch and Berschauer, new subspecies, holotype length 72.3 mm, holotype, LACM 3805, trawled from 250 m depth off Cabo Catoche, Quintana Roo State, Mexico; **G=** *Cinctura tortugana*, close-up of the protoconch and early whorls; **H=** *Cinctura keatonorum*, close-up of the protoconch and early whorls; **I=** *Cinctura tortugana traciae*, close-up of the protoconch and early whorls.

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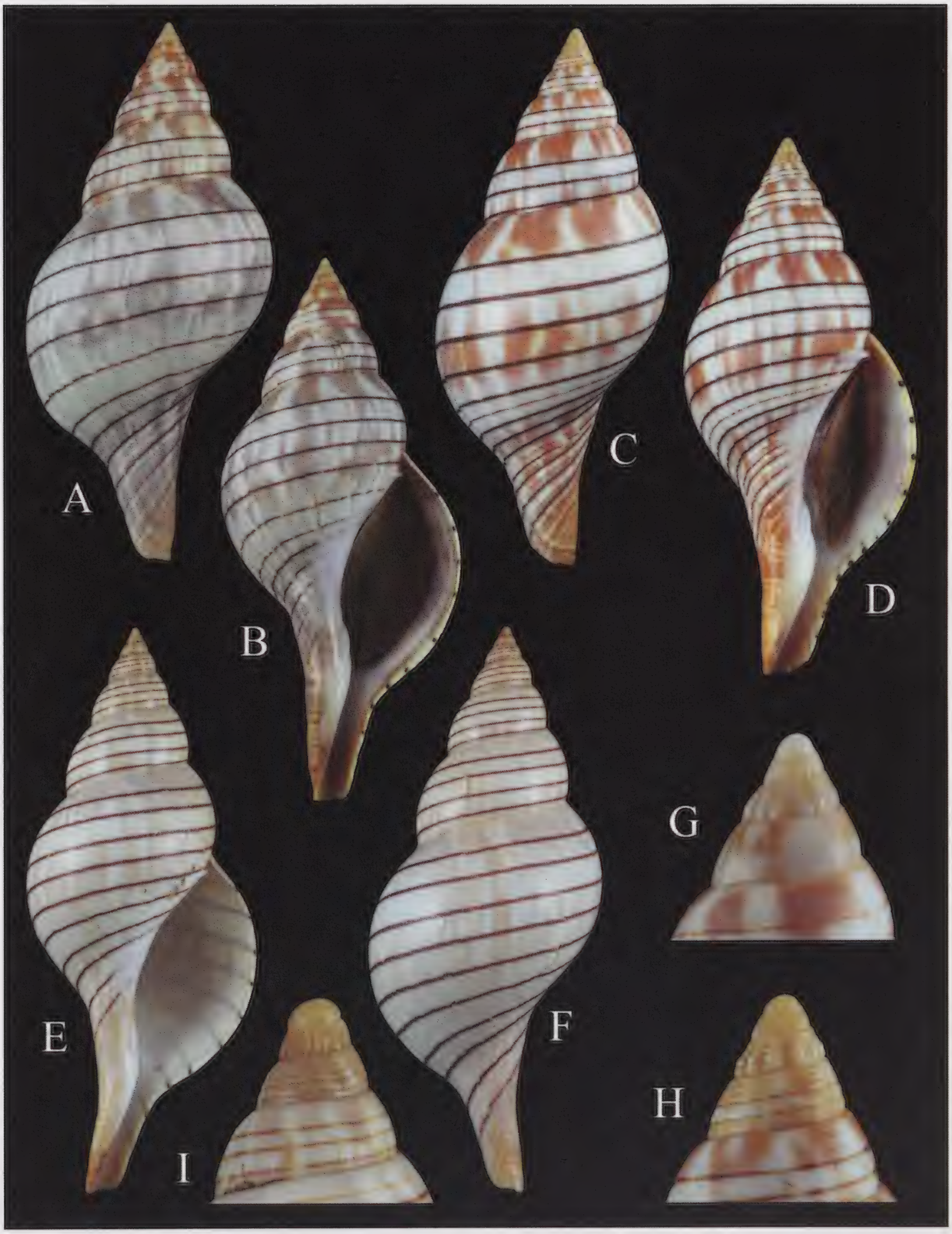

Figure 4. Members of the *Cinctura lilium* Species Complex, and *Cinctura branhamae* complex.
A, B= *Cinctura lilium* (Fischer von Waldheim, 1807), length 101 mm, 20 m depth off Mustang Island, Port Aransas, Nueces County, Texas. Petuch collection; **C, D=** *Cinctura lilium connori* Petuch and Berschauer, new subspecies, holotype, length 72.5 mm, LACM 3804, trawled from 250 m depth off Cabo Catoche, Quintana Roo State, Mexico; **E, F=** *Cinctura (Hollisteria) branhamae* (Rehder and Abbott, 1951), length 131 mm, trawled from 60 m depth north of Progreso, Yucatan State, Mexico. Petuch collection; **G=** *Cinctura lilium*, close-up of the protoconch and early whorls; **H=** *Cinctura lilium connori* Petuch and Berschauer, new subspecies, close-up of the protoconch and early whorls; **I=** *Cinctura (Hollisteria) branhamae*, close-up of the protoconch and early whorls.

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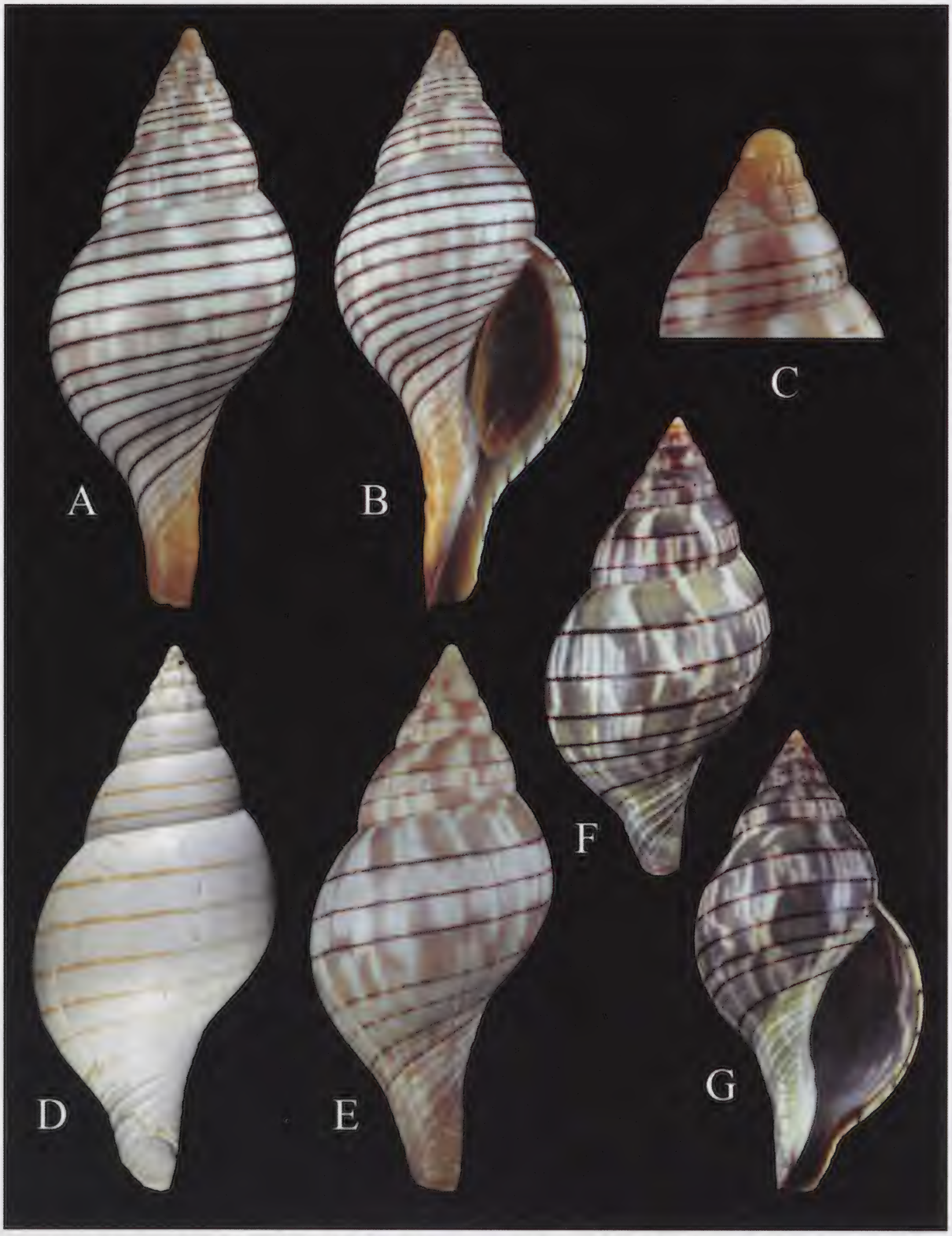

Figure 5. *Cinctura* species from the Georgian, Floridian, Suwannean, Texan, and Yucatanean Subprovinces of the Carolinian Molluscan Province.

A, B= *Cinctura (Hollisteria) branhamae morganae* Petuch and Berschauer, new subspecies, holotype length 71.2 mm, LACM 3806, trawled from 250 m depth off Cabo Catoche, Quintana Roo State, Mexico; **C=** *Cinctura (Hollisteria) branhamae morganae* holotype, close-up of the protoconch and early whorls; **D=** *Cinctura evergladesensis* (Petuch, 1991), length 47 mm, from the Belle Glade Member of the Ionian Formation, Palm Beach County, Florida, late Calabrian Age, Pleistocene. Petuch collection; **E=** *Cinctura lilium* (Fischer von Waldheim, 1807), length 59.0 mm, found on the beach, South Padre Island, Texas, (specimen similar to Fischer's holotype; Berschauer collection); **F, G=** *Cinctura hunteria* (Perry, 1811), length 64.9 mm, Alligator Point, Franklin County, Florida (collected near the westernmost end of the range for the nominate subspecies; Berschauer collection).

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Studies in *Canarium urceus* (Linné, 1758) Part 2: *Strombus anatellus* Duclos, 1844, *Strombus crassilabrum* Anton, 1839, *Strombus incisus* Wood, 1828 and *Strombus ustulatus* form *laevis* Dodge, 1946 (Neostromboidae: Strombidae)

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ABSTRACT Many valid species can hide buried within prior taxonomic revisions. These need to be examined before the taxonomist embarks on the challenging task of naming new taxa. In this study we re-examine the synonyms complied by Abbott (1960) under *Canarium urceus* (Linné, 1758), examining each taxon for morphological clarity and distinctiveness. After considering the written descriptions and type material in light of prior revisions, we suggest that there are three valid species buried within the *C. urceus* synonymy of Abbott. All three species can be differentiated from *C. urceus* in general form, being less equi-triangulate and lacking the strong shoulder knobbing of that species. In addition, all three species are distinguishable by their distinctive aperture colouration. *Canarium urceus* possesses a typically black aperture, *Canarium anatellum* (Duclos, 1844) can be differentiated by its typically uniformly red/orange aperture, while *Canarium incisum* (Wood, 1828) is recognisable by the typically orange columella and outer lip, and a more triangular form. *Strombus ustulatus* form *laevis* Dodge, 1946 is the classical well-known form from the Philippines and elsewhere that is recognisable by its white columella. As the name *laevis* was preoccupied, we have renamed the species *Canarium esculentum nomen novem*. We assessed *Strombus crassilabrum* Anton, 1839 to be a *nomen dubium*. Further, our revision provides an improved hypothetical framework for the evolution and radiation of this most adaptable and variable of organisms, through increased clarity, and the re-circumscription of hitherto described taxa with distinctive morphotypes and separate biogeographical ranges.

KEY WORDS *Canarium urceus, C. anatellum, C. incisum, C. esculentumm C. crassilabrum,* phenotype, synonymy, taxonomy

INTRODUCTION

In the first part of these studies on the *Canarium urceus* of Abbott (1960), Maxwell *et al.* (2020) appropriately redefined *Canarium urceus* (Linné, 1758), tying the species morphology with a determinate population, thus providing a definitive diagnosis for *Canarium urceus*. The delimitation of *Canarium urceus* provided the basis upon which to undertake a revision of the synonymy offered by Abbott (1960) for that species. The known synonyms are compared to the recircumscribed *Canarium urceus* to test the assessment of Abbott (1960). It has been previously demonstrated that Abbott (1960) tended to underestimate the number of species, lumping valid taxa into groups on broad morphological similarity (Dekkers and Maxwell

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2018; Maxwell *et al.* 2019a; Dekkers and Maxwell 2020).

The current revision identifies the discrete sampling locations that are hidden in the historical literature and synonymised under *Canarium urceus* (Linné, 1758) of Abbott (1960), and re-circumscribing them. In revisiting these samples, no *a priori* taxonomic judgment is made as to their cladistic relationships, and at this time discrimination is based on stability of shell characters.

METHODS

This synonymic revision involved two primary steps. The first step aimed to identify the *Canarium urceus* synonymies contained within Abbott (1960). To do this we obtained images of the type material for each of the identified taxa, and use the morphology of type specimens and iconotypes to determine potential species. Once identified, the second step involved examining each taxon for morphological clarity and distinctiveness from other members of the *Canarium urceus* of Abbott (1960). Where a taxon was clearly a synonym, it was listed under the species hypothesis with precedence. Plated examples are provided for all species that were recircumscribed.

SYSTEMATICS

Three taxa were recircumscribed. *Canarium insisum* (Wood, 1828) was shifted to an Indonesian location and form, correcting the error in assignment (Man in 't Veld 1988). *Canarium anatellum* (Duclos, 1844) was reinstated, and *Canarium esculentum*, *nomen novem*, was introduced to replace the preoccupied *Strombus ustulatus* form *laevis* (Dodge, 1946) (not *Strombus laevis* Perry, 1811 (= *Euprotomus bulla* (Röding, 1798)).

Superfamily: Stromboidea Rafinesque, 1815
Epifamily (Clade): Neostromboidae Maxwell, Dekkers, Rymer & Congdon, 2019b
Family: Strombidae Rafinesque, 1815
Genus: *Canarium* Schumacher, 1817
Type species: *Strombus urceus* Linné, 1758

Canarium anatellum (Duclos, 1844)

Type Material. *Strombus anatellus* Duclos, 1844 (Muséum National d'Histoire Naturelle, Paris (France) Collection: Molluscs (IM) MNHN-IM-2000-32467 (Figure 1).

Type Locality. The Kangean Islands, Indonesia, designated herein.

Original Description. Duclos (1844) provided no original description, with the name being introduced on plate 4, figures 11 and 12, and plate 21, figures 8 and 9, based on the Chenu (1859) plate sets (Sherborn and Smith 1911). The combination of illustration and binominal name is considered valid at the time of publication (ICZN 1999).

Figure 1. Syntypes of *Canarium anatellum* (Duclos, 1844) (Muséum National d'Histoire Naturelle, Paris (France) Collection: Molluscs (IM) two specimens **A and B**= MNHN-IM-2000-32467 illustrated- Duclos collection). Images form Duclos, 1844: **C**= pl. 4, figs. 11 and 12; **D**= pl. 21, figs. 8 and 9.

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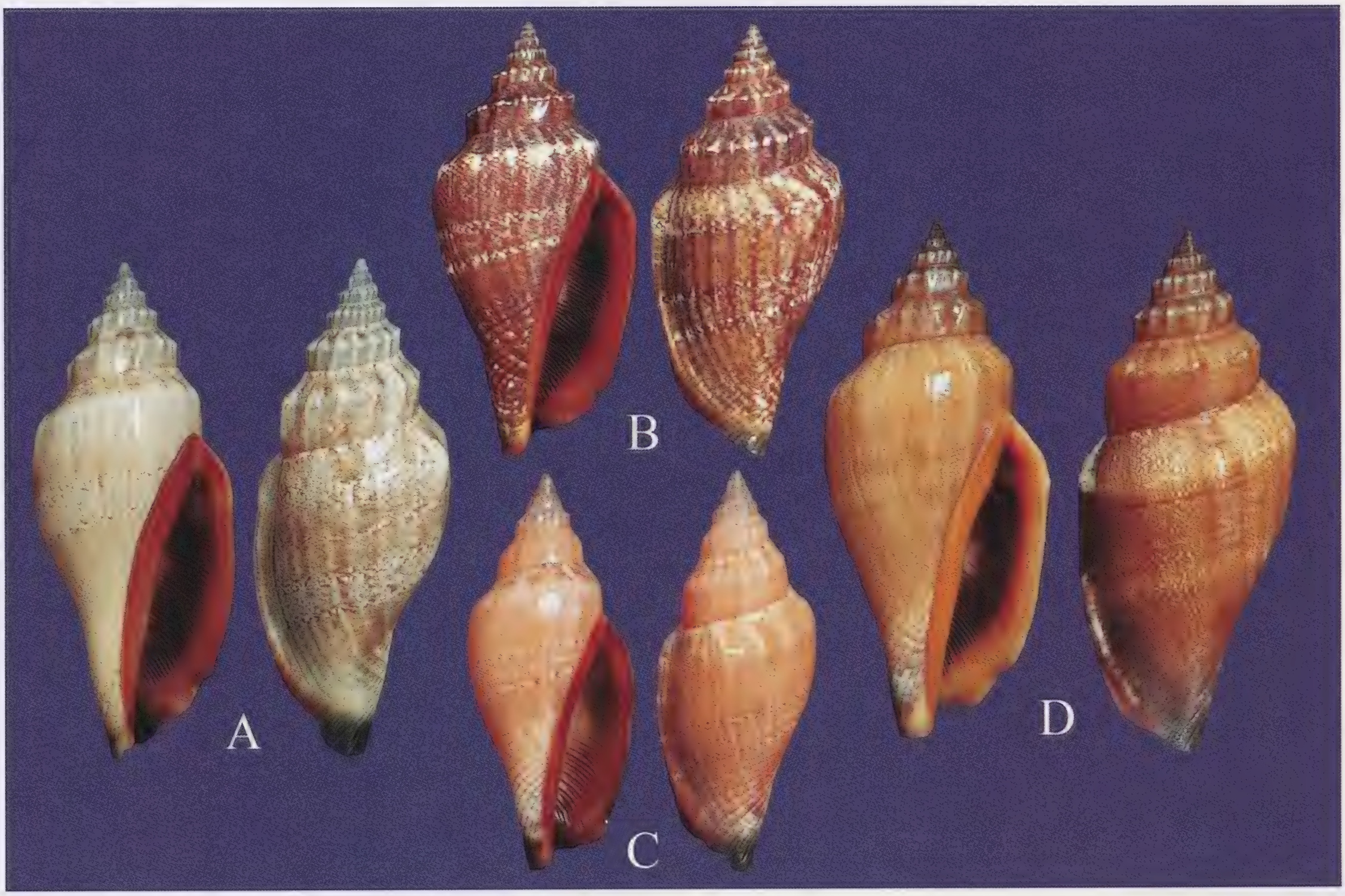

Figure 2. *Canarium anatellum* (Duclos, 1844) showing the red-orange columella, Kangean Islands, Indonesia, fisherman taken 2020: **A**= 52 mm (SMC 19b-006da); **B**= 45 mm (SMC 19b-006db); **C**= 36 mm (SMC 19b-006dc); **D**= 52 mm (SMC 19b-006dd).

Diagnosis. Key diagnostic feature is the uniformly red-orange toned columella and outer lip in combination with a slender shell with rounded shoulder (Figure 2).

Description. This ovate species has both a uniformly red-orange toned columella and outer lip. The shell is solid and smooth. The body whorl has axially aligned knobs on the shoulder. The columella is always smooth and, inside the labrum, it is red-orange with mostly dark coloured lirae entering deep inside the aperture; the last 4-5 mm towards the rim lose the brown colour. The outside colour is variable, with brown, green, cream, tan, yellow, orange, etc., and is mostly mottled. The anterior canal is almost always tipped with black within and on the outside. The whorls are rounded, with a weakly angled shoulder. The spire whorls have up to 17 axial shoulder knobs, which may be weak or obsolete. The base of the shell has 8 – 10 incised lines giving rise to flat cords. The aperture is elongated with a small but sharp posterior canal just ending under the shoulder.

Synonymy.

1844 *Strombus anatellus* Duclos, pl. 4, figs. 11 and 12, pl. 21, figs. 8 and 9. Tryon 1885, p. 118. Adam and Leloup 1938, p. 113. Dodge 1956, p. 285. Abbott 1960, pp. 65 and 66. Cernohorsky 1972, p. 74. Wagner and Abbott 1978, p. 09-652. Walls 1980, p. 188.

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Discussion. This ovately fusiform, medium-sized species is characterised by the red-orange columella and labrum. It has similar apertural colours to *Canarium incisum*, but *Canarium anatellum* differs in the form of the shell, *Canarium incisum* is also more triangulate and with a thicker and more quadrate aperture. *Canarium esculentum* is larger, with an actuate sinus at the upper aperture, with a predominantly white columella and a typical white labrum. *Canarium urceus* is a larger more fusiform species than *Canarium esculentum, Canarium urceus* differing in having a black coloured aperture with traces of deep plum.

Strombus crassilabrum Anton, 1839
nomen dubium

Type Material. Unknown.

Type Locality. Unknown.

Synonymy.

1839 *Strombus crassilabrum* Anton,
Verzeichniss der Conchylien Welche Sich in der Sammlung, p. 87, no. 2820 (Figure 3).

2820. 1. crassilabrum mihi, spitz-oval, Gewinde ziemlich niedrig, 6 convexe Windungen, letzte grösser als die übrigen zusammen, mit 3 kielartigen, äusserst flachen Reifen, sonst quergestreift, Mundsaum und Basis gefurcht; Naht gerandet, obersten Windungen mit kleinen Tuberkeln besetzt; blassgelb; Mündung schmal, oben sehr spitz zugehend, quergestreift, innen roth, aussen weiss; Spindel mit dickem Wulst, oben und unten gestreift, Mitte glatt, innen roth, äussrer Saum weiss; Mundsaum sehr stark, nicht geflügelt. Br. 7‴ H. 1″ 1‴. Die convexe glatte vorletzte Windung und die gesäumten Nähte nähern sie dem St. gibberulus, die dicke, in der Mitte glatte Spindel dem St. urceus, das wenig hohe Gewinde dem St. floridus. Ein Verbindungsglied obiger drei Arten.

Figure 3. Anton (1839 p. 87) original text for *Strombus crassilabrum*

Original Description. "2820. 1. *crassilabrum* in my collection, pointed oval, spire fairly low, 6 convex whorls, the last larger than the others together, with 3 keel-like, extremely flat spirals, otherwise with axials, aperture and base grooved; suture with band, uppermost whorls with small tubercles; pale yellow; Aperture narrow, pointed towards the top, striated across, red on the inside, white on the outside; Columella with thick callus, lirae at the top and bottom, smooth centre, outer edge white; apertural rim very strong, not winged. Br. 7 ′ ′ ′ H. 1 ′ ′ 1 ′ ′ ′. The convex, smooth penultimate whorl and the banded suture approach *St. gibberulus*, the thick, smooth columella in the middle *St. urceus*, the low spire *St. floridus*. A connecting link of the three species above." (Anton 1839, p. 87: translated AMD).

Discussion. *Strombus crassilabrum* is considered a *nomen dubium*. There are two taxa that have been linked to this name: *Canarium erythrinum* (Dillwyn, 1817) and *Canarium esculentum*. The two-toned colour of the aperture, particularly with the red inner and white outer surfaces, is not dissimilar in colour distribution to the aperture of *Canarium esculentum*, but that species is not known by the authors to have red on the collumella. The form of the columella is well defined and lirate top and bottom, which is not uncommon in either species it has been associated with. Within the literature, it is placed within the general synonymy of *Strombus urceus* (Abbott, 1960). However, it is not that species (Maxwell *et al.* 2020); the Anton (1939, no 2816) description for *Strombus urceus* Linné, 1758 is based on Martini's (1777) figures 803-806 (see Maxwell *et al.* 2020 for discussion on Martini) and its colour forms indicating that a different taxon to *Canarium urceus* was in his hands. WoRMS (2020) places it within the *Canarium erythrinum* complex without written justification.

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Canarium esculentum Maxwell, Rymer, Congdon & Dekkers, *nomen novem*
(Figure 5)

Type Material. The type is deposited in the American Museum of Natural History no. 12927 as the holotype of *Strombus ustulatus* form *laevis* Dodge, 1946, p.3. figs. 1 and 5 (Figure 4).

Figure 4. The holotype of *Strombus ustulatus* form *laevis* Dodge, 1946, p. 3, figs. 1 and 5 (American Museum of Natural History No. 12927).

Type Locality. We designate Olango Island, Philippines. Dodge (1946) gave no locality for his specimen.

Original Description. "I here propose for the extremely smooth form of *ustulatus* the name form *laevis*" (Dodge 1946, p. 3).

Diagnosis. The outer aperture is bordered with white, and the columella is two-toned, being white and pink (Figure 5).

Description. This species has both a uniformly white toned columella and rather slender fusiform to ovate appearance. The shell is medium sized, solid, smooth and relatively broad. Larger shells tend to be more slender. The body whorl has axially aligned knobs on the shoulder. The early whorls have mostly white varices, and a blueish black protoconch. The white columella is predominantly white, and is always smooth in the mid part; the posterior has ca. 10 lirae; and the anterior part 5-6 lirae. Inside labrum is yellowish-orange, with mostly dark coloured lirae entering deep in the aperture, the last 3-4 mm towards the rim has a pure white colour. Outside colour is variable with brown, green, cream, tan, yellow, orange, lilac, purple, etc., uniformly or mottled. The end of the anterior canal is almost always tipped with black within and on the outside. The body whorl is rounded, earlier whorls have a sharp angled shoulder diminishing in acuteness with growth. The penultimate whorls have 12-14 axial knobs at the shoulder, which may be obsolete. The base of the shell has 10 – 12 incised lines that gradually become less strong; the remainder of the body whorl covered with very thin spiral lines. The aperture is elongated with a small but sharp posterior canal just ending under the shoulder. The labrum is rather straight and not significantly thickened.

Synonymy.

Strombus ustulatus form *laevis* Dodge, 1946, p .3. figures 1 and 5. (not *Strombus laevis* Perry, 1811 (= *Euprotomus bulla* Röding, 1798 (Abbott, 1960).

Discussion. This is the *Canarium* species that is abundant in souvenir shops and which is eaten by the thousands in the Philippines. Dodge (1946) described this species as *Strombus ustulatus* form *laevis* Dodge, 1946. This is, however, a junior synonym of *Strombus laevis* Perry, 1811 (= *Euprotomus bulla*). As *S. laevis*

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Figure 5. *Canarium esculentum* Maxwell, Rymer, Congdon & Dekkers, *nomen novem* showing the bicoloured aperture, orange inside and with a white outline, Surigao, Philippines, Fisherman taken 2020: **A**= 39.5 mm (SMC U2-001k); **B**= 50 mm (SMC U2-001c); **C**= 34 mm (SMC U2-001e); **D**= 51 mm (SMC U2-001d).

was the first available name for this taxon, we had to rename the species. It is readily recognisable by the white columella in combination with the bicoloured aperture, orange inside and with a white outline. *Canarium urceus* has a black columella and aperture, whereas both *C. incisum* and *C. anatellum* have an orange columella.

Etymology. The species is named after the quantity of its consumption in the Philippines and the delicacy of its meat. The Latin word '*esculentus*' means *e.g.* delicious, edible, eatable, ripe.

Canarium insisum (Wood, 1828)

Type Material. *Strombus incisus* Wood, 1828, p. 14 pl. 4 fig. 12 (Figure 6). The illustration of Wood's incisus in the "Supplement to the Index Testaceologicus or A Catalog of Shells, British and Foreign" is selected as the type. Size approximately 40 mm (Abbott, 1960).

Figure 6. Type figure of *Strombus incisus* Wood, 1828, p. 14, pl. 4 fig. 12 (no locality).

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Figure 7. *Canarium incisum* (Wood, 1828): **A**= 29.5 mm, ex. coll. J.N.J. Post. Labuan Bajo, Binonko Beach, Flores, empty shell found on the beach at low tide. (AMD STR3271); **B**= 30 mm, ex. coll. J.N.J. Post. Labuan Bajo, Binonko Beach, Flores, empty shells found on the beach at low tide (AMD STR3271); **C**= 22 mm Kangean Islands, Indonesia, fisherman taken 2020 (SMC 19d.003k); **D**= 33 mm Kangean Islands, Indonesia, fisherman taken 2020 (SMC 19d.003m); **E**= 22 mm Kangean Islands, Indonesia, fisherman taken 2020 (SMC 19d.003j); **F**= 31 mm Kangean Islands, Indonesia, fisherman taken 2020 (SMC 19d.003n).

Type Locality. We designate Labuan Bujo, Benonko Beach, Flores, Indonesia, based on the collecting data of Hans Post (shells now in coll. AMD and Hans Post). Wood (1828) gave no locality data. The selection of the type locality by Man in 'T Veld (1988, p. 8) is in error: there was confusion of the species of Wood (1928).

Original Description. No original description. The combination of illustration (Wood 1828, pl. 4 fig. 12) and binominal name (Wood 1828, p. 14) was valid at the time of publication (ICZN 1999).

Diagnosis. Key diagnosis is a uniformly orange columella and 45° high shouldered outer lip, giving the shell a quadrate form (Figure 7).

Description. This bi-pyramidal species has both a uniformly red toned columella and rather high-shouldered outer lip. The shell is around 40-45 mm in length, solid, smooth, relatively broad. The body whorl is axially aligned knobs on the shoulder. The aperture is elongated, with a small but sharp posterior canal just ending under the shoulder. The orange columella is always smooth in the mid part: the posterior part has ca. 10 lirae and the anterior part 5-6 lirae.

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The inside labrum is orange with mostly dark coloured lirae entering deep in the aperture; the last 4-5 mm towards the rim lose the brown colour and take the orange colour. Outside colour variable with brown, green, cream, tan, yellow, orange, etc., mostly mottled with a dull white-greyish colour as the base colour. The anterior canal is almost always tipped with black within and on the outside. The body whorl has an angled shoulder, which may have axial knobs, with the largest being at the edge of the left dorsal shield and right ventral body whorl. Base of the shell has 8 – 10 incised lines giving rise to flat cords.

Synonymy.

1828 *Strombus incisus* Wood, p. 14 pl. 4 fig. 12a (no locality). Abbott 1960, p. 65 "Quadrate form".

1988 *Strombus urceus incisus* Wood – Man in 't Veld p. 7, fig. 2. only (b/w drawing from Wood).

Discussion. This medium-sized species is characterised by the orange columella and inside of the labrum. Man in 't Veld (1988) confused the drawing of Wood (1828) with an undescribed species ranging from the Solomon Islands to the New Hebrides. These shells have a higher thicker callused outer lip and shoulder and a white aperture. There are uncoloured examples of Wood (1828) and one is in the library of the fourth author. Thus, the mistake is likely caused by the colour of the columella. A similar yellow-orange columella and aperture is found in '*urceus*' from western Thailand. These Thailand populations are not connected to the Indonesian populations. The Thailand shells with orange columella are sturdy shells, growing larger on average than the Indonesian counter shells. The Thailand shells bear strong rounded knobs on the shoulder of the body whorl and the axials on the spire are fewer but stronger. Most of them also bear about 8-12 lirae on the posterior part of the columella and about 4-5 on the anterior part about the same as this species. The Thailand material will be addressed in Part 3 of this series. Similarly, *Canrium anatellum* lacks the shouldering of *Canarium incisum*, and has a red-orange aperture.

FUTURE RESEARCH

This paper is part 2 of a larger revision of the *Canarium urceus* (Linné, 1758) complex after Abbott (1960), reinstating species that were erroneously synonymized with *Canarium urceus*. The next steps deal with the circumscription of taxa historically considered as belonging to the *Canarium urceus* complex. The results of those analyses will then be used to aid in the development of a theory for the phylogeography of the *Canarium urceus* complex and the species contained within it.

ACKNOWLEDGEMENTS

We thank Hans and Marja Post, Diever, The Netherlands for the generous gift of self-collected strombid shells from Indonesia used in this study.

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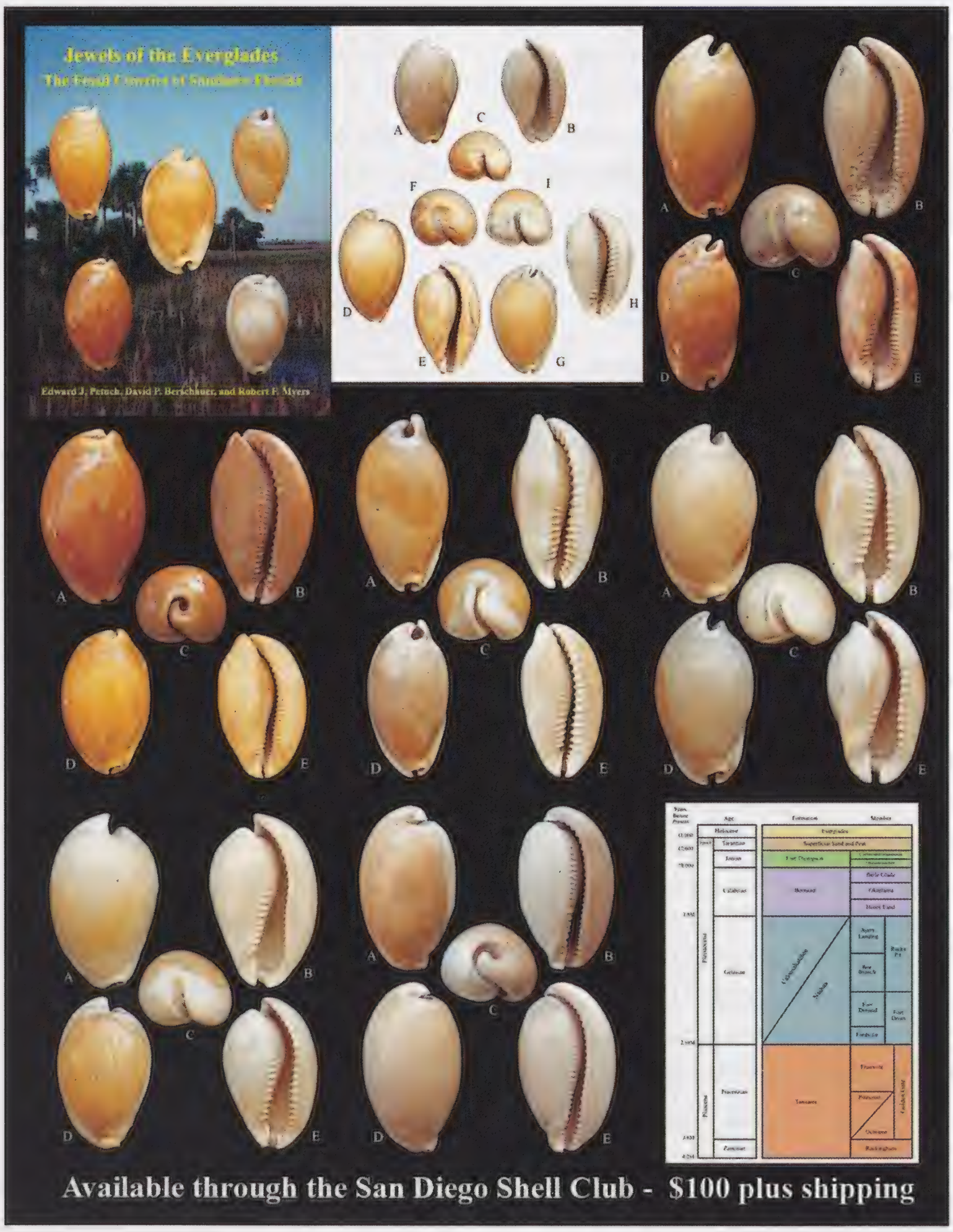

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Studies in *Canarium urceus* (Linnaeus, 1758) Part 3: new species from the western Pacific (Gastropoda: Neostromboidae: Strombidae)

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ABSTRACT This study introduces four new species within the *Canarium urceus* complex. *Canarium daveyi* nov. sp. and the sympatric *C. geelvinkbaaiensis* nov. sp. from the region surrounding Geelvink Bay in north-eastern Indonesia, *C. youngorum* nov. sp. from the island of north-eastern Papua New Guinea, and finally *Canarium manintveldi* nov. sp from the southern South Pacific centred on Fiji and Vanuatu. These new species differ from, and are described based on, the morphology and geographical distribution from known species belonging to the *C. urceus* complex. This study comprises part three in a series examining the broader *C. urceus* complex.

KEY WORDS *Canarium urceus*, *C. daveyi*, *C. geelvinkbaaiensis*, *C. youngorum*, *C. manintveldi*, Indonesia, new species, Papua New Guinea, Solomon Islands, taxonomy, Vanuatu, Fiji

INTRODUCTION

Historical revisions of the *Canarium urceus* (Linnaeus, 1758) complex have tended to grossly underestimate the diversity contained within the group, with a tendency to overlook the distinctive regional species (Dodge 1946, 1956; Abbott, 1960). A recent revision sought to define and restrict *C. urceus* to a distinctive regional morphotype centred on Singapore (Maxwell *et al.* 2020a). Additionally, a more nuanced approach to this taxon has disentangled those taxa previously described and recognised as species that have been buried by Abbott (1960) within the synonymy of that taxon (Maxwell et al. 2020b). Abbott (1960) is known for his oversimplification of the taxonomy of many groups of Mollusca (Turbinellidae – Dekkers and Maxwell 2018; Seraphsidae – Maxwell *et al.* 2018; Strombidae – Maxwell *et al.* 2019b). Abbott (1960) did recognise the diversity of the *C. urceus* complex. However, the lack of material at hand reflected in the distribution records contained within the work, meant that a complete understanding of the complex was not able to be achieved at that time, 60 years ago. Notwithstanding these limitations, Abbott (1960, p. 63) noted that "in addition to size, sculptural and color variations that appear within a single colony, there are other geographical clines and groups of morphological variations limited to certain rather discrete geographical areas". In this part the revision of the *C. urceus* complex, we explored the north-east of Indonesia (Geelvink Bay) to the south-western Pacific, and we recognise morphologically distinct species that are restricted in distribution that have been alluded to or overlooked by previous revisions (Dodge 1946, 1956; Abbott 1960).

Abbreviations.

AMD: Aart M. Dekkers Collection, Purmerend, The Netherlands.
H: Height.

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MNHN: Musée National d'Histoire Naturelle, Paris, France.
NBC Naturalis: Naturalis Biodiversity Center, Leiden, The Netherlands.
RMNH.MOL: Rijksmuseum voor Natuur Historie, housed within the NBC Naturalis, Leiden, The Netherlands.
SMC: Stephen Maxwell Collection, Cairns, Queensland, Australia.
VC Valda Cantamessa Collection, Proserpine, Queensland, Australia.
W: Width.
ZMA.MOLL: Zoölogisch Museum Amsterdam, housed within the NBC NCB Naturalis, Leiden.

METHODS

Seven examples of an usual *cf. C. urceus* were obtained from Davey Djaja Mulia, operating in the Geelvink Bay area by the first author. A second series of shells was found that conformed strongly to the "Geelvink form" identified by Abbott (1960). Further material was sourced from the collection of NCB Naturalis within the '*urceus*' lots. The NCB Naturalis houses the collections of the former RMNH and the now closed ZMA, and this contained a large number of Indonesian shells as a consequence of exploration when that region was a Dutch colony. During the examination of that material, this supplementary material confirmed the existence of two regionally restricted and distinct morphological kinds. The specimens were compared to the other species of *Canarium* Schumacher, 1817 with comparable morphological characters. In particular, these were compared to type material associated with other species within the *C. urceus* complex, namely *Strombus anatellus* Duclos, 1844, *Canarium esculentum* Maxwell, Rymer, Congdon and Dekkers, 2020b; *Strombus incisus* Wood, 1828 and *Strombus urceus* (Linnaeus, 1758). Furthermore, a new species historically misinterpreted as *C. incisum* Wood, 1828 from Indonesia (Man in 't Veld 1988) and left undescribed in part 2 of the *C. urceus* revisions (Maxwell *et al.* 2020b) is herein described. The misinterpretations of this species by Abbott (1960) and later Man in 't Veld (1988) were likely caused by the use of uncoloured versions of the plates of Wood, the less expensive versions of the work, as the hand coloured plates commanded a premium cost.

We have studied twenty-three examples of *C. daveyi* nov sp., fifty-three examples of *C. geelvinkbaaiensis* nov sp., and three examples of the rarer *C. youngorum* nov sp., with more of this species likely to be found as museum collections are further explored.

SYSTEMATICS

Superfamily: Stromboidea Rafinesque, 1815
Epifamily (Clade): Neostromboidae Maxwell, Dekkers, Rymer & Congdon, 2019a
Family: Strombidae Rafinesque, 1815
Genus: *Canarium* Schumacher, 1817
Type species: *Strombus urceus* Linnaeus, 1758

Canarium daveyi Dekkers & Maxwell, nov. sp.
(Figure 1)

Type Material. Holotype – RMNH MOL.112282a, H 21.2 mm, W 10.0 mm (Figure 1A); Paratype 1– RMNH MOL.112282b, H 24.4 mm, W 10.8 mm; Paratype 2 – RMNH MOL.112282b, H 24.2 mm, W 10.7 mm; Paratype 3 – RMNH MOL.112282b, H 19.3 mm, W 8.5 mm; Paratype 4 AMD STR3583a – H 31.4 mm, W 13.6 mm, a subadult example (Figure 1B); Paratype 5 – MNHN-IM-2012-25554, H 30.1 mm, W 13.1 mm (Figure 1C); Paratype 6 – MNHN-IM-2012-25555, H 30.3 mm, W 13.0 mm (Figure 1D); Paratype 7 – AMD STR3583b, H 32.2 mm, W 13.3 mm (Figure 1E); Paratype 8 – AMD STR3583c, H 26.6 mm, W 11.6 mm (Figure 1F); Paratype 9 – AMD STR3583d, H 29.0 mm, W 11.8 mm (Figure 1G); Paratype 10 – AMD

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Figure 1. Types of *Canarium daveyi* n. sp. southside of the Japen Island, Geelvink Bay, Indonesia: **A**= Holotype – 21.2 mm (RMNH MOL.112282a); **B**= Paratype 4 – 31.4 mm (AMD STR3583a); **C**= Paratype 5 – 30.1 mm (MNHN-IM-2012-25554); **D**= Paratype 6 – 30.3 mm (MNHN-IM-2012-25555); **E**= Paratype 7 – 32.2 mm (AMD STR3583b); **F**= Paratype 8 – 26.6 mm (AMD STR3583c); **G**= Paratype 9 – 29.0 mm (AMD STR3583d); **H**= Paratype 10 – 28.3 mm (AMD STR3583e).

STR3583e, H 28.3 mm, W 12.6 mm (Figure 1H); Paratype 11 – SMC 19b.001, H 32.5 mm, W 14.1 mm (Figure 5C).

Type Locality. We designate Paulau Auri, ca. 1 mile NE off Palau Rumwakon, Geelvink Bay, Indonesia as the type locality.

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Diagnosis. The key diagnostic feature is the small and slender shell, with 3 orange-brown coloured bands on a white shell colour and a white aperture.

Description. Slender and rather small shells for the *C. urceus* complex: average height 26.6-32.5 mm (types). The shell is lightweight, shiny and thin walled. Spire whorls consists of two protoconch whorls, which are coloured white to mostly purple glassy, and five more whorls with many axials. Earlier whorls with thinner axial ribs and some varices. Body whorl dorsally rather smooth, with the exception of axially aligned knobs on the shoulder, axial growth lines and spiral ridges that run along the anterior canal, becoming obsolete towards the shoulder. The axial ribbing continues on the ventral side of the shell, as the spiral ribbing towards the anterior end. Spire whorls with a ramp towards the shoulder. Penultimate whorl runs back to the shell below the shoulder. The rather straight and narrow wing has a strong ridge just before the end of it, only dorsally. Aperture wide, with a well-defined columellar callus that is sharply cut and raised a bit, attached to the ventral side of the body whorl with a gutter. Smooth columella in the middle and both ends bear strong white lirae. Place of attachment below the shoulder. Inside of the outer lip with visible white spiral lirae. Outer lip thickened and white. Strombid notch very shallow, almost obsolete. Colour of the shell consists of three vague bands of orange-brown on a white background, the one at the anterior end broadest and the one under the suture smallest. These bands show through at the aperture. The white bands end in four white spots on the outside part of the labrum and a broad one at the anterior end. The anterior channel ends in a black spot.

Comparison and remarks. *Canarium daveyi* nov. sp. is, at this stage, believed to be restricted to the region of Geelvink Bay. *Canarium daveyi* nov. sp. differs from the recent *C. urceus* from the Philippines and Central Pacific by its much smaller and lightweight shell; the sculpture is finer and the colouring is very different from *C. urceus*, with its black aperture, or the multi-coloured sister species *C. esculentum* from the Philippines with its white aperture. Compared to *C. esculentum*, it has a constant colour with three orange-brown bands on a white background, and never any black or orange on the aperture as other morphs in the complex. *Canarium daveyi* nov. sp. differs from the *C. geelvinkbaaiensis* nov. sp., which has a blue-black lower third of the body whorl, no lirae on both ends of the columella and a bit longer posterior channel.

Canarium manintveldi nov. sp. from the Solomon Island and Vanuatu has a similar size range to *C. daveyi* nov. sp, but is much broader than it is high and the aperture and shoulder are almost on the same level as the suture. The typical form of this species is easy to recognize. *Canarium youngorum* nov sp. from the islands of eastern Papua New Guinea differs in being larger, and has a typical red aperture and uniform angled axial folds at the shoulder, which may be diminished in some specimens.

Etymology. The new species is named after Davey Djaja Mulia from Jakarta, Indonesia, who collected the shells during leisure time at his work on the Island of Palau Japen and brought this new species to the authors' attention.

Supplementary Material. *Indonesia* Seroei, Japen Island, ex coll. L. de Priester (RMNH MOL.179483 x 1); Coral coast near Hollandia, leg. G. den Hoed (ZMA MOLL.48218 x 1); Dohreh-baai, ex coll. E.F. Jochem (RMNH MOL.179467 x 1); Wandammen Bay, Wasior. Geelvink Bay. leg. G.V. Hansen (ZMA MOLL.50579 x 3); Serui, Japen Island, ex coll.

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Daan Smits (ZMA MOLL.50570 x 4). Note: Dohreh-baai = Dorey-Bay = smaller west part of Geelvink Bay); Dohreh (= Dorey, present day Manokwari).

Canarium geelvinkbaaiensis Dekkers & Maxwell, nov. sp.
(Figure 2)

Type Material. Holotype – RMNH MOL.179571a, Manokwari, ex coll. Kaas & ten Broeke, collected by Mevr. M.v d Wiel, 1956, H 24.5 mm, W 10.9 mm (Figure 2B); Paratype 1 – RMNH MOL.179571b, Manokwari, ex coll. Kaas & ten Broeke, collected by Mevr. M.v/d Wiel, 1956, H 28.3 mm, W 12.9 mm (Figure 2A, 5H). Paratype 2 – MNHN-IM-2012-25556, from Manokwari, Leg. Daan Smits 1958, H 27.2 mm, W 12.9 mm; Paratype 3 – MNHN-IM-2012-25557, from Manokwari, Leg. Daan Smits, 1958, H 28.1 mm, W 14.2 mm; Paratype 4 – AMD STR3689a, from Manokwari, Leg. Daan Smits, 1958, H 28.5 mm, W 13.1 mm; Paratype 5 – AMD STR3689b, from Manokwari, Leg. Daan Smits, 1958, H 28.1 mm, W 14.5 mm; Paratype 6 – AMD STR3689c, from Manokwari, Leg. Daan Smits, 1958, H 26.6 mm, W 11.6 mm; Paratype 7 – from Manokwari, Leg. Daan Smits, 1958, SMC 19e.001, H 25.3 mm, W 12.4 mm (chipped protoconch).

Type Locality. We designate Manokwari, West Guinea, Indonesia as the type locality.

Figure 2. Types of *Canarium geelvinkbaaiensis* nov. sp. from Manokwari, Indonesia: **A=** Holotype – 28.3 mm (RHNH MOL.179571b); **B=** Paratype – 24.5 mm (RHNH MOL.179571a).

Diagnosis. The key diagnostic feature is a small and slender shell decorated with 2 vague brownish bands on a white base colour, and the anterior part of the shell toward the anterior channel with a dark brown to black band that is broadest at the ventral side of the shell.

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Description. Slender and rather small shells for the *C. urceus* complex, height between 21.2-29.5 mm (types), but mostly around 27-28 mm. The shell is lightweight, shiny, and has thin shell walls. Spire whorls consists of about three protoconch whorls, mostly brown-purple and glassy, and 4-5 more whorls with many axials. Earlier whorls with thinner axial ribs and sometimes old varices. Body whorl dorsally rather smooth with the exception of axially aligned knobs on the shoulder, and ca. 10 stronger spiral ridges that run along the anterior canal; the remainder of the body whorl bears many very thin spiral lines that become obsolete around and above the shoulder. No visible axial growth lines. The axial knobs dorsally are preceded on the ventral side of the shell, just towards the aperture in the paratypes 2-7 and in the holotype and paratype 1 the ventral side is smooth. It is preceded on the penultimate whorl with about 20-21 finely raised knobs that form the axial ribbing in that whorl, and form a corona on the shoulder. This is preceded on the earlier whorls, becoming more and more tiny. Spire whorls with a smooth ramp from the simple suture towards the shoulder; after the coronation on the shoulder the shell becoming smaller, giving a sharp edged shoulder. Penultimate whorl runs back to the shell below the shoulder. The rather straight and narrow wing has a strong ridge of about 2.5-3 mm just before the end of it, only dorsally and not internally reinforced. Aperture narrow, with a well-defined columellar callus that is sharply cut and raised a bit, attached to the ventral side of the body whorl with a gutter. Smooth columella to the naked eye, but some tiny lirae near the small posterior sinus. Place of attachment below the shoulder of the penultimate whorl. Inside of the outer lip with many clearly visible, but thin, white spiral lirae, that become brown after about 4 mm. Outer lip white. Strombid notch very shallow, about 1 mm deep and 4 mm wide. Colour of the shell dirty white with 2 greenish bands. Old shells dirty white with purple hue dorsally and two vague bands of orange-brown that start mid dorsally and end before the reinforced lip; the one at the anterior end broadest and darkest and the one there under the longest and the lightest of colour. These bands show through at the aperture. The anterior part of the shell toward the anterior channel with a dark brown to black band that is broadest at the ventral side of the shell.

Synonymy.

Strombus (Canarium) urceus 'Geelvink Bay form' Abbott (1960 p. 64, pl. 41, fig. 3). Dutch New Guinea.

Etymology. The new species is named after the type location, Geelvink Bay, as Dutch name it (Geelvink Baai).

Comparison and Remarks. Abbott treated *C. geelvinkbaaiensis* nov. sp. as an unnamed form of *S. (C.) urceus* coming from Dutch New Guinea (now: West Guinea, part of Indonesia). He also mentions Palaus and Ponape Island in the Carolinas. Abbott does not depict these shells coming from these island chains. We were unable to locate any material matching *C. geelvinkbaaiensis* nov. sp. outside of north-west Indonesia, and thus we are not able to confirm these locations. The species is easily recognisable by the fine beaded shoulder in combination with the brown-black broader band at the anterior end. *Canarium. geelvinkbaaiensis* nov. sp. has three vague brownish bands where *C. daveyi* nov. sp. only has two bands. Ecological records indicate that the species can be found from 20-25 fathoms in association with weed, sponge and rubble.

Supplementary Material. 1/2 mile south of Ambai, Japen Island. ex coll. Philidelphia Ao. Soi. reg. no. 1408. Nat. Sci. Foundation

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(RMNH MOL.112281 x 1); Doreh Baai, ex coll. E.F. Jochem (RMNH MOL.179467 x 4, dead coll.); coast near Sara Wandori, West of Serui, Japen Island, expedition L.D. Brongersma c.s. 1954-1955 (RMNH MOL.179489 x 1); Beach of Sorong, ex. coll. Mr. P. van Royen, reg. No. 1112 (RMNH MOL.179491 x 2); Near Seroei Leg. D. Smits, ex coll. J. van der Land (RMNH MOL.179541 x 3); Manokwari, ex coll. Kaas & ten Broeke (RMNH MOL.179561 x 7); Doreh Baai, ex coll. E.F. Jochem (RMNH MOL.179566 x 1); Bay of Seroei, Japen Island, ex coll. D. Smits (no. 298), reg. no. 1453 (RMNH MOL.179567 x 8); Palau Roon, Geelvink Bay, ex coll. L. de Priester (ZMA MOLL.45999 x 1); Serui, Japen Island, ex. coll. Daan Smits (ZMA MOLL 50570 x 5); Wandammen Bay, Wasior, Geelvink Bay, leg. G.V. Hansen (ZMA MOLL 50579 x 7); Serui Bay, ex coll. Bergström, leg. Smits D. 298 (ZMA MOLL.73838 x 8). Note: Dohreh-baai = Dorey-Bay = smaller west part of Geelvink Bay. Dohreh = Dorey = present day Manokwari.

Canarium manintveldi Dekkers & Maxwell, nov. sp.
(Figure 3)

Type Material. Holotype – ZMA MOLL. 187523a, H 20.1 mm, W 10.3 mm, Malapoa, Vila, Vanuatu , ex. P. Hessel coll. (Figure 3A); Paratype 1 – ZMA MOLL.187523b, H 18.6 mm, W 10.1 mm, Malapoa, Vila, Vanuatu , ex. P. Hessel coll. (Figure 3B); Paratype 2 – Crab Bay, Malekula, Vanuatu, AMD STR2817, H 20.0 mm, W 10.5 mm; Paratype 3 – Madang, North coast Papua New Guinea, AMD STR1625, H 21.8 mm, W 10.5 mm; Paratype 4 – Vanuatu Islands, 1-2 meter depth on reef AMD STR2551, H 19.7 mm, W 10.8 mm; Paratype 5 – Uoei Island, Solomon Islands, H 16.1 mm, W 9.1 mm (SMC 21.003); Paratype 6 – Irirka Islands, Vanuatu, H 19.1, W 10.5 mm (SMC 21.001a); Paratype 7 – Lord Howe Island, H 24.9 mm, W 13.1 mm (SMC 21.002); Paratype 8 – Kakabona, Solomon Islands, H 28.9 mm, W 12.9 mm (SMC 21.004a); Paratype 9 – Irirka Islands, Vanuatu, H 18.2 mm, W 10.0 mm (SMC 21.001b).

Type Locality. We designate Malapoa, Islands, Vanuatu as the type locality.

Diagnosis. The species is constant in having the aperture raised above the shoulder of the body whorl with a greatly thickened callus either side of the sinus at the posterior end.

Description. Shells small in size for the *C. urceus* complex, height between 20-28 mm (types), but mostly around 20 mm in the Solomons Islands and Vanuatu and becoming larger (27-29 mm) in the southern range. The shell is sturdy and the body whorl is almost smooth and shiny. The width of the shell is variable, from relatively slender to broad at the shoulder. Spire whorls consists of about three protoconch whorls, regularly becoming larger. Dirty white to brown-purple, and 4-5 more whorls with many axials. Earlier whorls with tiny axial ribs and old varices. Body whorl dorsally rather smooth to the naked eye but on close inspection with ca. 6 slightly stronger spiral ridges that run along the anterior canal, and the remainder of the body whorl with many very thin spiral lines that become obsolete around and above the shoulder. No visible axial growth lines. Body whorl with a central knob on the shoulder; the axial knob dorsally is proceeded towards and on the ventral side of the shell, just towards the aperture. It is succeeded on the penultimate whorl with about 13-20 finely raised knobs that form the axial ribbing in that whorl, and form a corona on the shoulder. This is proceeded on the earlier whorls,

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Figure 3. The types of *Canarium mantinveldi* nov. sp.: **A**= Holotype – Malpona,Vila, Vanuatu, 20.1 mm (ZMA MOLL.187523a); **B**= Paratype 1 – Malpona,Vila, Vanuatu, 18.5 mm (ZMA MOLL.187523b); **C**= Paratype 5 – Uoei Island, Solomon Islands, 16.1 mm (SMC 21.003); **D**= Paratype 6 – Irirka Islands, Vanuatu, 19.1 mm (SMC 21.001a); **E**= Paratype 7 – Lord Howe Island, 24.9 mm (SMC 21.002); **F**= Paratype 8 – Kakabona, Solomon Islands 28.9 mm (SMC 21.004a).

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becoming more and more tiny. Spire whorls with a smooth ramp from the simple suture towards the shoulder; after the coronation on the shoulder the shell is becomes smaller giving a sharp edged shoulder. The earliest whorls are straighter. Penultimate whorl runs back to the shell well above the shoulder, even surpassing the suture. The rather straight and narrow wing has a strong ridge of about 2.0-2.5 mm just before the end of it, only dorsally and not internally reinforced. Aperture very narrow, with a well-defined columellar callus that is sharply cut and raised a bit, attached to the ventral side of the body whorl with a deep gutter. Smooth columella to the naked eye, but some tiny lirae near the small posterior sinus. The aperture callus is bulbous at the posterior end where it is raised above the suture; it is so thick that the posterior channel is often very shallow. First 1 mm of the inside of the outer lip smooth, then with many thin white spiral lirae on a white to brownish background inside the aperture. Outer lip white. Strombid notch very shallow, about 1 mm deep and 3-4 mm wide. Colour of the shell dirty white with more or less purplish hue dorsally and very vague broad bands of blueish-brown that start dorsally and (as the ventral side is dirty white) end before the reinforced lip. Towards the lip they can fuse into a broad axial band. Sometimes these bands do show through at the inside of the aperture. The anterior part of the shell toward the anterior channel with a dark brown to black band that is broadest at the ventral side of the shell, but the last 1 mm is often white.

Synonymy.

Strombus (*Canarium*) *urceus incisus* Wood – Man in 't veld 1988, p. 6-10.

Strombus (*Canarium*) *urceus incisus* Wood – Cernohorsky 1972, p. 74; pl. 20, fig. 2. Walls 1980, pp. 107, 108. Kreipl *et al.* 1999, pp. 12, 40; pl. 76.

Strombus urceus Linnaeus – Hinton 1972, p. 10; pl. 5, fig. 15.

Strombus urceus urceus Linnaeus – Hinton 1978, p. 11, no. 14.

Strombus (Canarium) incisus Wood – Abbott 1960, p. 64, pl. 41, fig. 4 'Quadrate form'. 'a form close to incisum' – Romagna Manojo 1980, pl. 1, fig. 9 (no locality).

Etymology. The new species is named after Leo Man in 't Veld, Vlaardingen, The Netherlands, a painter (drawings and airbrush) and well known Strombidae collector in the Netherlands. He mixed up the newly described species named after him with the species Wood named *Canarium incisum*, which has an orange columella. We also honour Leo for his fine artwork in Kronenberg & Visser, 1984; the plates in this book (in Dutch) is almost entirely based on his collection and this species name recognises his unrecognised contribution to that work.

Comparison and Remarks. The new species is readily recognized by its high shouldered aperture with a thickened callus at the posterior end combined with a white columella. It is the only species in the complex that has the very high shouldered aperture. It can be confused with *C. orrae* Abbott, 1960 from west-northern Australia, but that species is much larger (up to 35-50 mm) and rugged, with stepped spire whorls.

Abbott (1960) treated the new species as the 'quadrate' form of *C. urceus*. He probably realised it could be a species (Abbott: 64): "An additional and evidently closely related form appears to have received the name *incisus* Wood, 1828. We have this form from the Solomons and from other localities of which the data is questionable and "… it may subsequently be considered a subspecies…". The conclusion is that: 1) Abbott was convinced

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that it is an additional form and 2) he mixes it up with the true Indonesian *C. incisum* of Wood, 1828, which is highlighted in part 2 of the *C. urceus* revisions (Maxwell *et al.* 2020b). Leo Man in 't Veld (Man in 't Veld, 1988) made the same mistake as Abbott, both most likely caused by an uncoloured version of Wood's work. We must bear in mind that much of Abbott's (1960) designated subspecies are now considered full species. The latest example is in the genus *Doxander* (Kronenberg & Wieneke 2020).

Canarium youngorum Dekkers & Maxwell, nov. sp.
(Figure 4)

Type Material. A) Holotype – Manus Island, H 35.6 mm, W 16.1 mm (QM MO85756); B) Paratype 1 – Rabaul, H 37.9 mm, W 22.5 mm (SMC 19f.001); C) Paratype 2 – Rabaul, H 35.3 mm, W 15.5 mm (VC).

Type Locality. We designate Manus Island, Papua New Guinea as the type locality.

Diagnosis. Shell of medium size with uniform axial folds that reach the suture on the spire and are sinusoidal on the ventral body of whorl the shoulder.

Description. The fusiform shells are medium sized for the *C. urceus* complex; height between 35-40 mm (types). The shell is thin with a uniformly thickened outer lip. The spire is approximately one third to one quarter the length of the shell. The protoconch is smooth consisting of one or two whorls. The first spiral whorls are convex smooth with a subsutural chord (paratype 1), that may be indistinct in some specimens due to wear (holotype), and

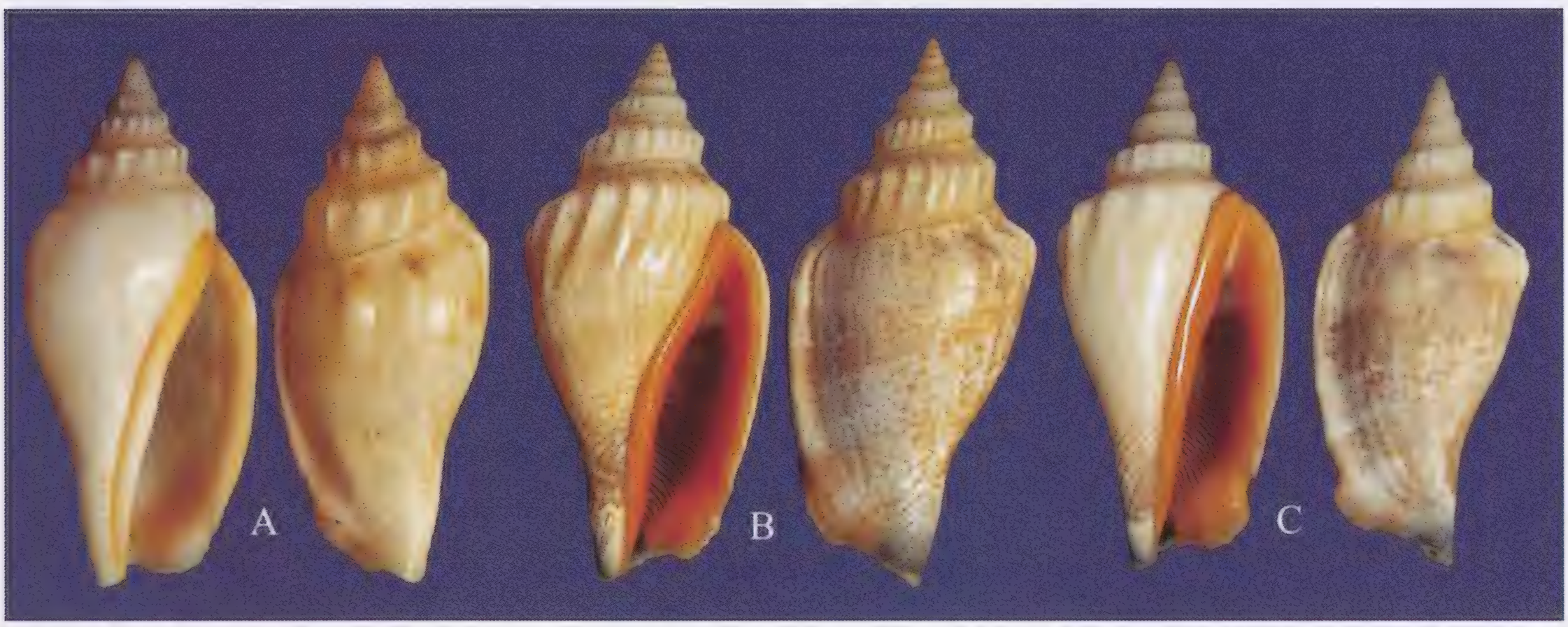

Figure 4. The types of *Canarium youngorum* nov. sp.: **A**= Holotype – Manus Island 35.6 mm (QM MO85756); **B**= Paratype 1 – Rabaul 37.9 mm (SMC 19f.001); **C**= Paratype 2 – Rabaul 35.3 mm (VC).

without varices. Varices appearing only on the third and fourth whorls, typically with three per whorl. Later spire without the earlier subsutural chord that forms into a short subsutural ramp, becoming moderately angulated at the shoulder. The shoulder of latter whorls with distinctive and regular small axial folds that reach the suture of the proceeding whorl. The folds tend to be skewed spirally forward as they descend the whorl. There is an absence of spiral

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sculpture on the spire. The ventral body whorl with the same uniform axial folds that do not extend below the top one third of the whorl, these may be diminished in some specimens. The dorsal body whorl folds have diminished in number, becoming axially elongated knobs, which do not extend much past the mid-dorsum. The edge of the outerlip is dorsally stepped and thickened in contrast to the smooth shell. The stromboid notch is moderately shallow but well formed. The spiral striae on the lower third body whorl reduce in width towards the anterior. The columella is uniform in thickness, with a few faint, but distinct, lirae at the anterior and posterior ends. Both the columella and outerlip share the same uniform colouration, typically red. The columella and outerlip join below the shoulder of the body whorl, forming two sides of a shallow sinus. The inner aperture with many fine raised lirae that move more toward the edge of the outer lip anteriorly, and which become darkly stained over a plain interior base colour. The colour and pattern of the shell is small fine white tents on a tan shell giving the appearance of axially formed maculations. The colour of the inner aperture can be seen through some specimens, giving the appearance of a dark hue to the area preceding the outer lip. The lower third of the body whorl may contain a dark stain in some examples, being a continuation and deepening of the colour of the inner aperture.

Etymology. This species is named in honour of Trevor and Marguerite Young of Cannonvale, Queensland, who, as active citizen scientists, have supported many budding taxonomists and proffered new insights leading to new molluscan species being described.

Comparison and Remarks. Currently *C. youngorum* nov. sp. is only known from the far north eastern islands of Papua New Guinea. However, it is expected that this range will be expanded as further explorations of museum records are further undertaken. *C. youngorum* nov. sp. differs from *C. manintveldi* nov. sp., by the uniform thickening of the outer lip and larger size. The spire, sculpture and size distinguish *C. youngorum* nov. sp. from its western neighbours, *C. geelvinkbaaiensis* nov. sp. and *C. daveyi* nov. sp..

DISCUSSION

We have demonstrated that the *urceus*-complex has four more related species in the north of Papua Island and the Solomon-Vanuatu chain of Islands. Most remarkable is *Canarium manintveldi*, which was for a long time wrongly known under the name of C. *incisus*. All the new species described differ from *C. anatellum, C. esculentum* and *C. urceus* by their much smaller and lightweight shells; the sculpture is finer and the colouring is constant in all specimens, lacking the colouration variability found in multi-coloured *C. anatellum* and *C. esculentum* (Figure 5), nor do they have the uniformity in black colouration associated with *C. urceus*. Furthermore, the new species introduced herein complete the distribution of the *C. urceus* complex in the south-western Pacific. In particular, C. *youngorum* nov. sp. is distributed between the new species contained in the northern Indonesian *C. geelvinkbaaiensis* nov. sp. and *C. daveyi* nov. sp and the south-eastern *C. manintveldi* nov. sp. and are not currently known to be congruent with other species within the *C. urceus* complex.

FUTURE RESEARCH

This paper is part 3 of a larger revision of *Canarium urceus* (Linnaeus, 1758) after Abbott (1960), describing species form the south-western Pacific. The next steps in this study series will examine the morphotypes that

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surround the western areas of the central Indo-Pacific.

ACKNOWLEDGEMENTS

We thank Jeroen Goud, curator of NCB Naturalis for help, access to the shells of NCB Naturalis in his custody, the loan of specimens. The authors thank Davey Djaja Mulia from Jakarta, Indonesia for the gift of Geelvink Bay shells he collected, leading to the recognition as new species herein.

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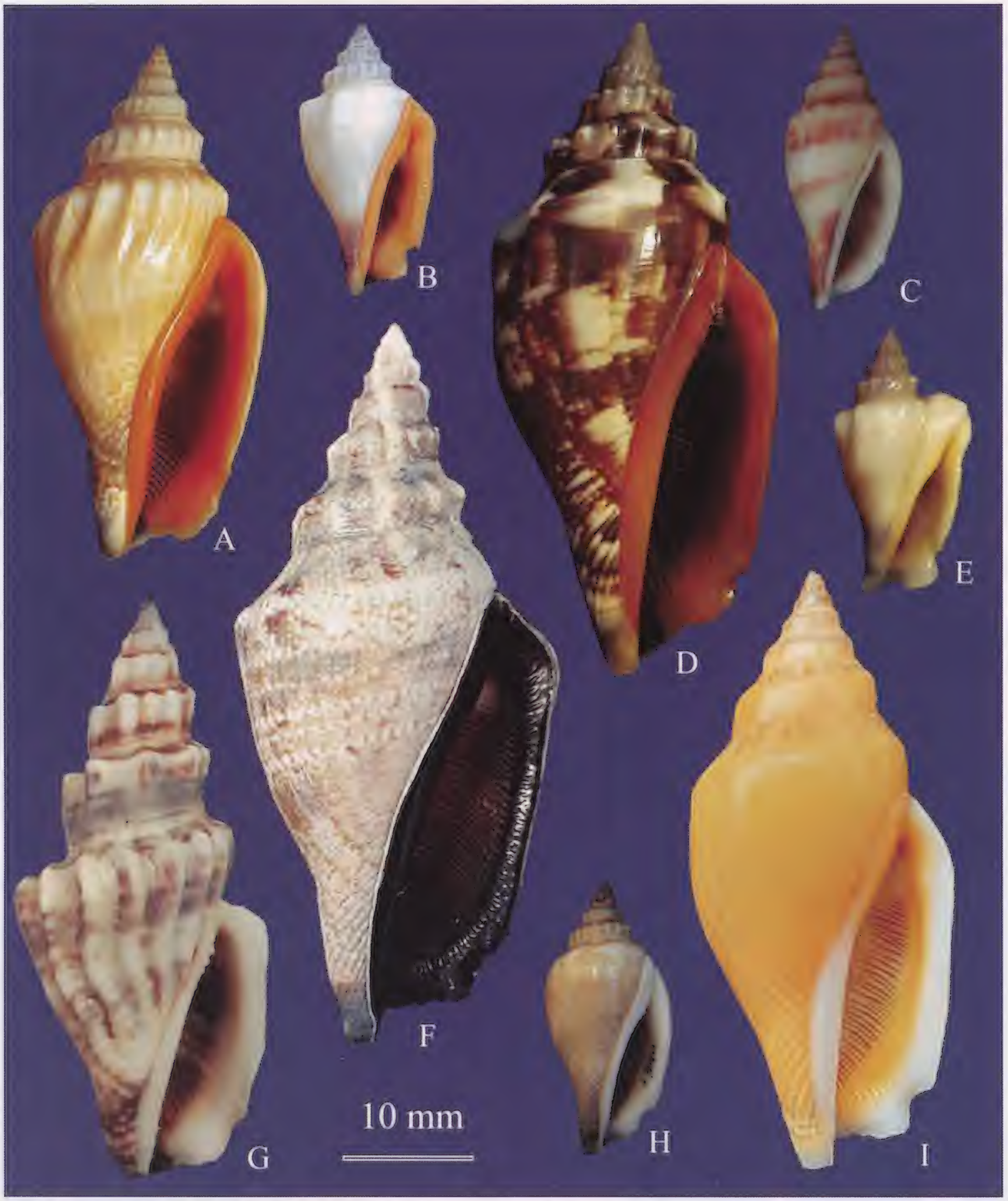

Figure 5. The Strombidae the that have historically been buried within the *Canarium urceus* complex: **A**= *C. youngorum* nov. sp., Rabaul, Papua New Guinea, 37.9 mm (Paratype 1; SMC 19f.001); **B**= *C. insisum* (Wood 1828), Kangean Islands, Indonesia (SMC 19d.003j); **C**= *C. daveyi* nov. sp., Geelvink Bay, Indonesia, Paratype 11, 32.5 mm (SMC 19b.001); **D**= *C. anatellum* (Duclos, 1844), Kangean Islands, Indonesia (SMC 19b.003v); **E**= *C. mantinveldi* nov. sp., Irirka Islands, Vanuatu, Paratype 9, 18.2 mm (SMC 21.001b); **F**= *C. urceus* (Linnaeus, 1758) Changi Beach, Singapore (SMC U1.002); **G**= *C. orrae* (Abbott, 1960) Onslow, 41.5 mm (SMC 20.006); **H**= *C. geelvinkbaaiensis* nov. sp., Manokwari, Indoneisia, 28.3 mm (RMNH MOL.179571); **I**= *C. esculentum* Maxwell, Rymer, Congdon and Dekkers, 2020, Surigao, Philippines (SMC 19a.001ab).

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Remarks on *Amphidromus reflexilabris* Schepman, 1892, *Amphidromus roseolabiatus* Fulton, 1896, *Amphidromus anhduongae* Thach, 2020 and correction of errors in "New Shells of South Asia, Volume 2"

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ABSTRACT The species *Amphidromus reflexilabris* Schepman, 1892, *Amphidromus roseolabiatus* Fulton, 1896 and *Amphidromus anhduongae* Thach, 2020 have been misidentified in many websites on the Internet. The diagnostic characters of these land snails are elaborated in this article for accurate identification. In addition, typographical errors in "New Shells of South Asia, Volume 2" are identified and corrected.

KEY WORDS *Amphidromus, A. reflexilabris, A. roseolabiatus, A. anhduongae, A. berschaueri, A. pamabbasae, A. chrisabbasi, A. severnsi luangprabangensis, A. koonpoi, A. givenchyi*

TAXONOMIC COMMENTS

Amphidromus reflexilabris Schepman, 1892

This species was described by M. Schepman in 1892 from three specimens ranging in length from 39.5 to 50.0 mm (one of which was a juvenile) collected at Amarassi on Timor Island. The lectotype was deposited at the National Museum of Natural History (Leiden, the Netherlands). *Amphidromus berschaueri* Thach, 2018 (Figures 1, 4), *A. pamabbasae* Thach, 2017 (Figure 5) and *A. chrisabbasi* Thach, 2017 (Figure 6) differ mainly from *A. reflexilabris* (Figures 2, 3) by lacking the characteristic canal running along the dorsal side of the outer lip, giving the appearance of a thick peristome (Figure 3 a) as noted in the original description (see Schepman in 1892 at page 152, line 23 of Notes from the Leyden Museum. Vol. XIV). The canals of the three above-mentioned *Amphidromus* species (marked respectively by "b", "c" and 'd" in Figures 4, 5 and 6) are not curled forming a rounded tube along the dorsal side like that of *A. reflexilabris*. In the original description, Schepman wrote that "this species varies very much in size and color". However, he did not state that *A. reflexilabris* is very variable in sculpture, shape and pattern as suggested by Páll-Gergely *et al.* (2020) (see page 54, left column). In that article, Páll-Gergely *et al.* stated that the above-cited *Amphidromus* were merely color forms of a single species and proclaimed *A. berschaueri, A. pamabbasae* and *A. chrisabbasi* to be synonyms for *A. reflexilabris*. This synonymisation is erroneous because the sculpture, shapes, patterns, apex, colors and sizes (*i.e.* the main features of a shell) are different and distinctive for each of these species. For instance, their shapes are characteristically different from that of *A. reflexilabris*, in that their apertures are more pointed at the anterior end, columellas are not similar, spiral bands are present on the body whorl, and apexes are black; not yellowish like *A. reflexilabris* (see page 153, line 2 of the original description). These unique and distinctive characters cannot be ignored; they form the foundation upon which science distinguishes one species from another. Observations made by shell dealers and collectors can be invaluable because they often

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have the opportunity to inspect many more specimens of a species than academic researchers. In these circumstances, malacologists should cooperate with dealers and collectors instead of criticizing them. Here, the differences between these species are clearly distinguishable and are well known among collectors and dealers.

Amphidromus roseolabiatus Fulton, 1896

This species was described by H. Fulton in 1896 from two specimens (one adult 36 mm and one juvenile) collected in Thailand. In the original description, this species has a pink lip and columella (see page 89, lines 21 and 22, Series 6 of The Annals and Magazine of Natural History). Illustrated in Figure 7 is a specimen collected in Thailand (32.8 mm) by my team. Specimen E of Fig. 45 in Inkhavilay *et al.* (2019) and specimens C to F of Fig. 4 in Inkhavilay *et al.* (2017) are not typical specimens of *Amphidromus roseolabiatus* because they do not have the characteristic pink-red outer lip and columella. They are closer to *Amphidromus severnsi luangprabangensis* Thach & F. Huber, 2020 (Figure 8), collected in Laos. Páll-Gergely *et al.* (2020) stated that the reddish line along the suture is characteristic of *A. roseolabiatus* (see page 54, right column, line 33). However, this is not the case and is evidenced by the lack of this feature on the specimen shown in Figure 9 of this article and Figs. 4A to 4F of this species in Inkhavilay, Sutcharit & Panha (2017). Further, Páll-Gergely *et al.* (2020) suggest that *A. roseolabiatus* and *A. koonpoi* Thach & F. Huber 2018 (Figure 9) are synonyms for a single species. However, the three characteristics of *A. roseolabiatus* suggested by Páll-Gergely *et al.* (2020) (*i.e.,* corpulent shell, reddish line along the suture and yellow-greenish stripes) are not observed in *A. koonpoi*. This raises the question as to whether these selected characters are diagnostic of *A. roseolabiatus* as suggested by Páll-Gergely *et al.* Consequently, it is incumbent upon any author when presenting a new species that they clearly show the unique characters that distinguish the new species from the previously described species. It must be the same when considering a new species as a synonym of a described species; the reviewer must provide evidence showing the similarities between the new species and described species. Unfortunately, Páll-Gergely labeled a number of the new species described in "New Shells of Southeast Asia", 2017, 128 pgs. N.N. Thach" and "New Shells of South Asia", Volume 1, 2018, 173 pgs. and Volume 2, 2020, 189 pgs. N.N. Thach" as synonyms without providing any clear evidence of that determination. As Editor of MolluscaBase and Author, Páll-Gergely has an inherent conflict of interest and should recuse himself from making such determinations without proper peer review. It is similar to a soccer match where one of the players is also the referee.

Amphidromus anhduongae Thach, 2020

This species (Figures 10, 11) was described by N. N. Thach in 2020 in the book "New Shells of South Asia, Volume 2" and can be easily differentiated from *A. givenchyi* Geret, 1912 (Figures 12, 13) by ten important features presented on page 50 of the book. Inkhavilay and colleagues had incorrectly identified this species as *A. givenchyi* in a number of articles: Inkhavilay *et al.* (2017) (see Fig. 2C and 4I); Inkhavilay *et al.* (2019) (see Fig. 43D); and Sutcharit & Panha (2006) (see specimen No. 4P). This has been compounded with a number of specimens similarly misidentified on the Internet. Páll-Gergely *et al.* (2020) also made an error in suggesting that *A. richgoldbergi* Thach & F. Huber, 2017 (page 52, right column, line 17) and *A. roseolabiatus* (page 52, right column, line 29) are the same species and synonyms of *A.*

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givenchyi. The unique characters of a red-pink outer lip and columella of *A. roseolabiatus* clearly distinguishes it from *A. givenchyi* and is well known to dealers and collectors.

ERRATA TO "NEW SHELLS OF SOUTH ASIA, VOLUME 2"

Page 66: *A. kiattani* is replaced by *A. kiati*.
Page 75 (left column), line 5: delete Fig. 878 & 880.
Page 82 (right column): *Bouchetcamaena thachi* No 917* to 920* is replaced by *Bouchetcamaena thachorum* No 919* to 922*.
Page 87 (left column): Genus *Lamprellia Stanisic*, 2010, line 3 &11: *Lamprellia franzhuberi* is replaced by *Lamprellia huberi* and line 15: *L. franzhuberi* is replaced by *L. huberi*.
Page 93 (left column), line 26: Fig. 963* is replaced by Fig. 975.
Page 94 (left column), line 14: Fig. 973 is replaced by Fig. 985.
Page 172 (Plate 69): Figure captions: 838*, 839*: *Amphidromus thachorum*: Cambodia is replaced by Laos.
Page 183 (Plate 80): Figure captions: 919* to 922*: *Bouchetcamaena thachi* is replaced by *Bouchetcamaena thachorum*, 923* to 926*: *Philbouchetcamaena huberi* is replaced by *Philbouchetia franzhuberi*.
Page 186 (Plate 83): Figures captions: 955*: *Rhagada vietnamensis n.sp.* is replaced by *Rhagada setzeri vietnamensis n.ssp.*
Page 189 (Plate 86): Figures captions: 980*, 981* is replaced by 990*, 991*.

ACKNOWLEDGMENTS

The author thanks A.N. Van der Bijl, R.G. Moolenbeek, J. Goud and the Leiden Center of Biodiversity for the photo of *Amphidromus reflexilabris* in their book on M. M. Schepman, the Paris National Museum of Natural History for the photo of *A. givenchyi* and the anonymous reviewers for their works on this article.

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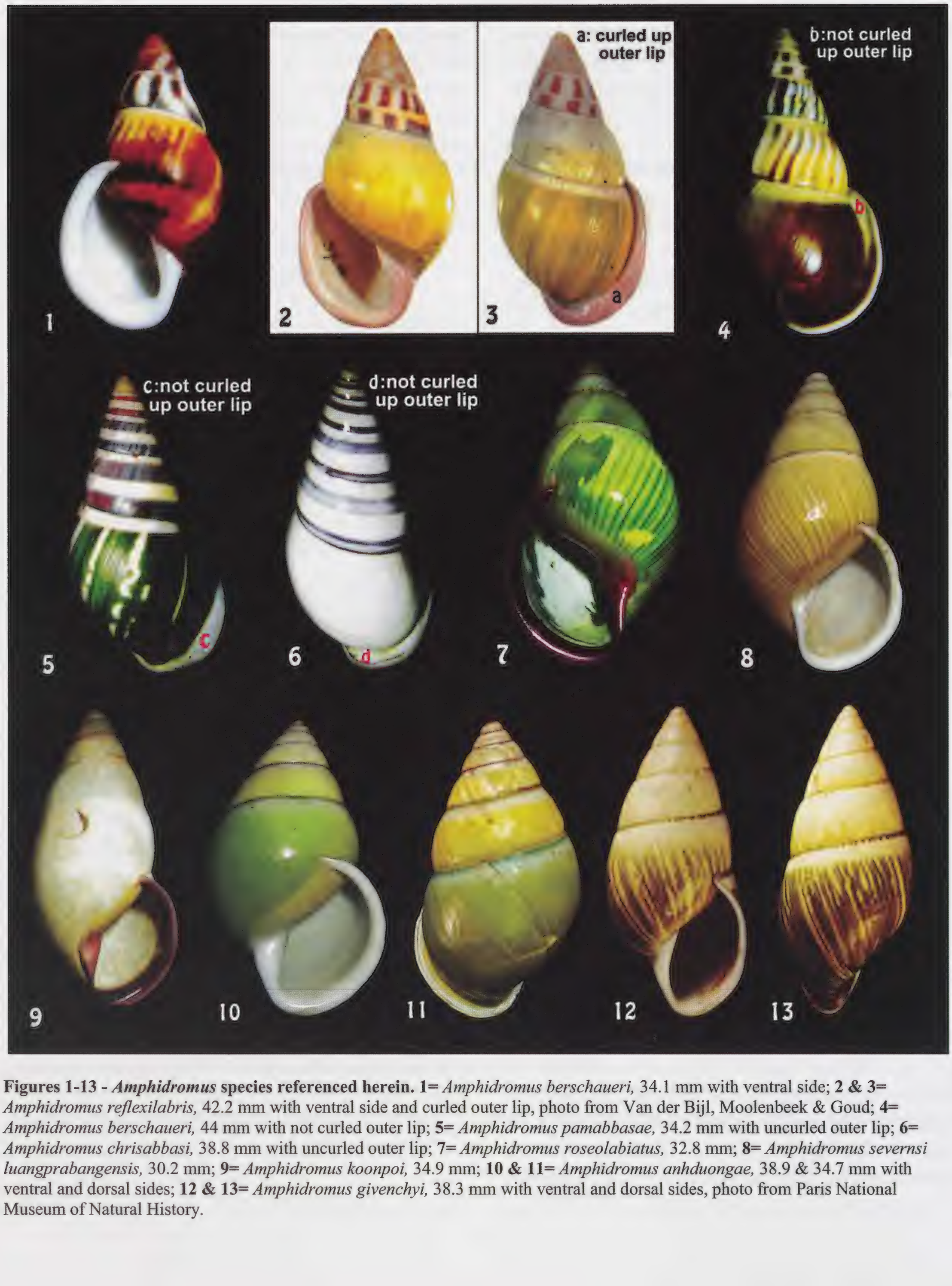
ISSN 0738-9388



Figures 1-13 - *Amphidromus* species referenced herein. 1= *Amphidromus berschaueri,* 34.1 mm with ventral side; **2 & 3=** *Amphidromus reflexilabris,* 42.2 mm with ventral side and curled outer lip, photo from Van der Bijl, Moolenbeek & Goud; **4=** *Amphidromus berschaueri,* 44 mm with not curled outer lip; **5=** *Amphidromus pamabbasae,* 34.2 mm with uncurled outer lip; **6=** *Amphidromus chrisabbasi,* 38.8 mm with uncurled outer lip; **7=** *Amphidromus roseolabiatus,* 32.8 mm; **8=** *Amphidromus severnsi luangprabangensis,* 30.2 mm; **9=** *Amphidromus koonpoi,* 34.9 mm; **10 & 11=** *Amphidromus anhduongae,* 38.9 & 34.7 mm with ventral and dorsal sides; **12 & 13=** *Amphidromus givenchyi,* 38.3 mm with ventral and dorsal sides, photo from Paris National Museum of Natural History.

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Revision of the subgenus *Lineamarginella* S.G.Veldsman, 2017 (Marginellidae: *Marginella*), including the description of three new species from South Africa

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ABSTRACT The subgenus *Lineamarginella* S.G. Veldsman, 2017 is revised and three new species are described: *Marginella olearegina* n. sp., *M. valae* n. sp., *M. lauriesmithi* n. sp. from the East Coast Province and Agulhas Province, South Africa. The three new species are compared to *Marginella lineolata* G.B. Sowerby III, 1886, *M. hayesi* Bozetti, 1993, and *M. san* S.G. Veldsman, 2014, respectively.

KEYWORDS *Marginella, Lineamarginella, M. olearegina, M. valae, M. lauriesmithi, M. lineolata, M. hayesi, M. san,* South Africa

INTRODUCTION

The Marginellid subgenus *Lineamarginella,* as described by Veldsman (2017, 2019) is characterized by large shells, broad-pyriform shaped, with a rounded shoulder and a sharp pointed lip edge on the posterior end. The posterior notch is slightly developed and has no labial denticles. Callus is slightly developed on the columella. The shell sizes within this subgenus ranges from 20-40 mm. The species within this subgenus have a wide range of habitats: beach collected, scuba dived, dredged, and trawled from Algoa Bay (Eastern Cape) and the Agulhas Bank, South Africa (Figure 1).

The subgenus *Lineamarginella* has been of interest to several authors: Hart (1987), Lorenz (1992), Hayes & Millard (1995), Els & Beltman (1996), Veldsman (2014, 2017). Els & Beltman (1996) discuss their *lineolata – hayesi – lineofasciata – lussi* species complex, around False Bay area, and illustrated a remarkable population of shells that is (according to them) an intermediate form between *M. lineolata* and *M. hayesi*. Lorenz (1992) illustrates specimens of *M. lineolata* from False Bay and Jeffreys Bay and mentions that specimens from False Bay have rather sparse pattern, whereas those from Jeffreys Bay have denser and darker patterns. Hart (1987) illustrate a live animal of a specimen from False Bay and mentions that the Port Elizabeth shells of *M. lineolata* tends to be smaller, more heavily marked and lives in gravel under large

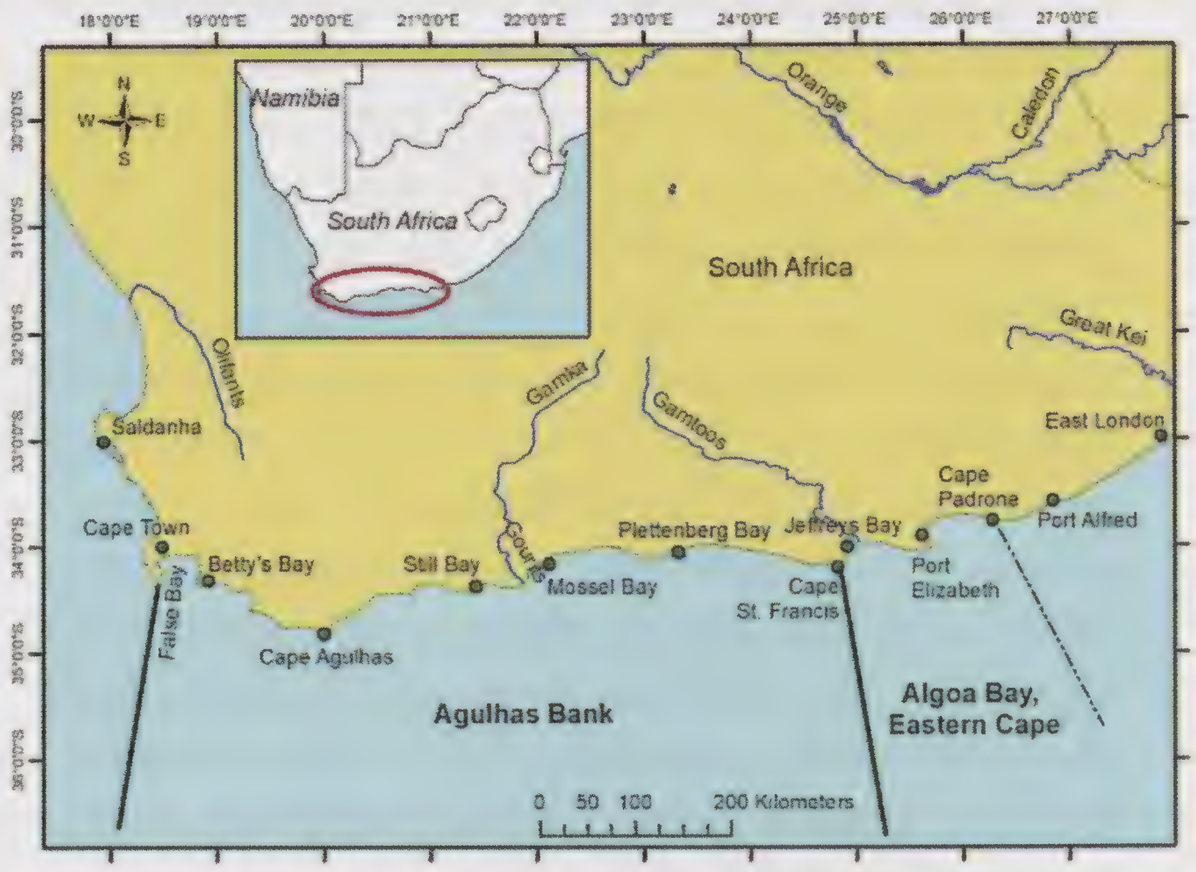

Figure 1. Locality map indicating the region of the Agulhas Bank and Algoa Bay, Eastern Cape, South Africa.

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boulders on the reef rather than in sandy areas (as in False Bay), and in 1997, illustrate several variable specimens from False Bay to Jeffreys Bay. Specimens within the *Lineamarginella* subgenus have been recorded north of Algoa Bay, at East London, but it is questionable whether the locality is correct.

The *Marginella* subgenus *Lineamarginella*, S.G.Veldsman, 2017, is revised here and three new species are described: *Marginella (Lineamarginella) olearegina* n. sp., *M. (L.) valae* n. sp., *M. (L.) lauriesmithi* n. sp. from Agulhas Bank and Algoa Bay, Eastern Cape, South Africa. The three new species are compared to *M. (L.) lineolata* G.B. Sowerby III, 1886, *M. (L.) hayesi* Bozetti, 1993, and *M. (L.) san* S.G.Veldsman, 2014.

SYSTEMATICS

Mollusca Linnaeus,1758
Gastropoda Cuvier, 1795
Marginellidae Fleming, 1828
Marginella Lamarck, 1799
Lineamarginella Veldsman, 2017

Marginella (Lineamarginella) lineolata
G.B. Sowerby III, 1886
(Figures 2, 3, 5.5, 5.6, 7.1, 7.3, 7.4)

Sowerby (1886) described *M. (L.) lineolata* (Figure 2) and later illustrated the type specimen from Port Elizabeth in Sowerby (1892) (Figure 3).

Most of the specimens of *Marginella (L.) lineolata,* studied by the author, came from Port Elizabeth with a few specimens from Jeffreys Bay (Algoa Bay, Eastern Cape), South Africa. Specimens were collected from different depths between 20 m and 100 m.

M. lineolata Sowerby, nov. sp. — *Testa pyriformis, lævis cærulescente-cinerea, punctis tenebrosis unbratis hic illic conspersa; lineis numerosis tenuissimis undulatis longitudinaliter notata ; spira conica, apice obtuso ; anfractus superne concavo-declives, deinde convexi ; anfr. ultimus convexus, superne sub-humerosus, inferne leviter attenuatus ; apertura latiuscula ; labrum reflexum, albidum ; columella rectiuscula, quadriplicata. Long. 30, lat. 15.*

Shell pyriform, smooth, bluish ash colour, with here and there a sprinking of dark shaded spots, and marked with numerous very thin longitudinal waved lines; spire conical, with an obtuse apex; whorls concavely sloping above, thence convex; last whorl convex slightly shouldered above and a little attenuated towards the base; aperture rather wide; lip reflexed, whitish; columella rather straight four-plaited.

Beach-rolled specimens of this species have been familiar to me for some time, but a perfect specimen having now come to hand, I describe it, as I could not have done previously.

Figure 2. Original description of *Marginella (L.) lineolata* by Sowerby (1886).

Figure 3. Illustration of *Marginella (L.) lineolata* by Sowerby (1892).

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The shell is large (24-29 mm), broad-pyriform shaped, with a rounded shoulder and a slightly pointed lip edge towards the posterior end. The posterior notch is slightly developed and has no labial denticles. Callus is slightly developed on the columella. Spire short in height and broad, spire whorls convex and slightly stepped. Wide protoconch, light olive to yellowish creamy color. Columella rather straight with four continuous plications, which take up half the length of the aperture, off-white color. Aperture wide, off-white color. Background color of dorsum of the body whorl as described by Sowerby (1886), a bluish ash color, with here and there a sprinkling of dark shaded spots, and marked with numerous very thin longitudinal waved lines. Background color of spire similar to that of the dorsum. Moderately thick labrum, lip slightly bend to straight, with light bluish grey fine markings on dorsal side of edge.

Marginella (Lineamarginella) san
S.G.Veldsman, 2014
(Figure 4.4, 4.5, 7.6 & 8.4)

The shell is large in size (29-35 mm), broad-pyriform shape with a rounded shoulder and sharp pointed lip edge on posterior end. Shell surface smooth, spire conical, medium in height (24% on average), slightly wide protoconch, obtuse apex, off-white. No labial denticles or posterior labial notch. Columella, with four continuous plications, the lower (fourth) plica ending at base of shell. Callus covering only the lower two plicae. Aperture straight, moderately broad, off-white color. Thick lip, off-white color, no markings on the labrum, slightly bumpy on labial edge. Background color of the body whorl is off-white to a very light yellow, sometimes a very light grey. Two broad bands around body whorl, consisting of broken black to dark brown markings. Body whorl has very thin, light grey longitudinal waved lines, widely spaced, consistently carrying on over the shoulder onto the spire (Veldsman 2014).

The type locality of *M. (L.) san* is False Bay (34°10′S & 25°03′E), Western Agulhas Bank, South Africa. All specimens studied were recovered by diving in False Bay at depths between 10-45 m. It was previously believed that this species also occurs at Mossel Bay to the east, but the specimens from Mossel Bay are significantly different (and are illustrated as *M.* species 2 - Figure 4.6).

Marginella (Lineamarginella) hayesi
Bozetti, 1993
(Figure 4.1, 6.5 & 6.6)

The shell is large in size (32-40 mm). Bozetti (1994) described this species as: "Shell fusiform-oval, shiny, with protruding spire; wide and rounded protoconch of 1.5-2 whorls; teleoconch of 4 whorls, the early 2 with an almost straight outline, and the last 2 convex-subangulate. Aperture high, narrow, with maximum width at the middle; external lip curved, internally smooth, externally strengthened by a thick and sharpened margin on the edge opposite to the aperture. Sculpture of weak and beveled axial costae, more evident at the shoulder, unevenly distributed. Four columellar plicae, less prominent and oblique in adapical direction; siphonal canal developed, slightly rostrated in the back; columellar callus not evident. Ground color solid flesh pink; a spiral band crammed with brown-bluish net-like dashes covers the central half of the last whorl; in the earlier whorls, the superior edge of this band barely juts over the suture. The pink of the edge fades into white towards the aperture; peristoma, columellar plicae and interior of the mouth white; several growth lines lighter than the background are present under the gloss."

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The type locality of *M. (L.) hayesi* is Betty's Bay (Bozetti 1993), South Africa at 30m. Other specimens' studied came from Betty's Bay (40 m) and Danger Point (45 m), both False Bay area, western Agulhas Bank, South Africa.

Marginella (Lineamarginella) valae
S.G.Veldsman, n. sp.
(Figure 5.3, 5.4, 8.1, 8.2 & 8.3)

Description. The shell is large (23-36 mm), broad-pyriform shaped, has a sharp rounded shoulder and a pointed lip edge on the posterior end. The posterior notch is slightly developed and has no labial denticles. Callus is slightly developed on the columella. Spire high and broad, spire whorls convex and stepped. Wide protoconch, off-white to light creamy color. Columella rather straight with four continuous plications, which take up half the length of the aperture, off-white to light creamy color. Aperture wide, off-white to light creamy color. Background color of dorsum of the body whorl creamy colored, two broad bands around body whorl, consisting of sparse dark brown markings / spots. Body whorl has vague, very thin, brown longitudinal waved lines, consistently carrying on over the shoulder onto the spire. Background color of spire similar to that of the dorsum. Thick labrum, lip slightly bent to straight, creamy background color on dorsal side of edge, no specific markings.

Distribution. Type locality of *M. (L.) valae* n. sp. is Jeffreys Bay, Eastern Cape, South Africa; beach collected. All specimens studied were collected at Jeffreys Bay. The species occur in shallow water with most specimens either beach collected or dived at depths of up to 20 m.

Type material. The type material of the holotype and paratypes of *M. (L.) valae* are as follows:

Holotype: 32.74 x 18.58 mm (Figure 5.3); Jeffreys Bay, beach collected, 1986; Coll. Natal Museum South Africa (NMSA), ID No: P1441/T4400; Donated by S.G. Veldsman.

Paratype 1: 30.46 x 17.01 mm (Figure 5.4); Jeffreys Bay, beach collected, 1982; Veldsman Collection.

Paratype 2: 30.78 x 17.79 mm (Figure 8.1); Jeffreys Bay, beach collected, 1986; Veldsman Collection.

Paratype 3: 35.79 x 21.31 mm; Jeffreys Bay, beach collected, 1986; Veldsman Collection.

Paratype 4: 27.27 x 15.79 mm (Figure 8.3); Jeffreys Bay, beach collected, 1986; Veldsman Collection.

Paratype 5: 31.90 x 18.74 mm (Figure 8.2); Jeffreys Bay, beach collected, 1986; Veldsman Collection.

Paratype 6: 27.80 x 17.10 mm; Jeffreys Bay, beach collected, 1986; Veldsman Collection.

Paratype 7: 28.77 x 16.35 mm; Jeffreys Bay, beach collected, 1986; Veldsman Collection.

Paratype 8: 30.03 x 17.17 mm; Jeffreys Bay, beach collected, 1986; Veldsman Collection.

Paratype 9: 25.05 x 15.10 mm; Jeffreys Bay, scuba 20m, 1982; Veldsman Collection.

Paratype 10: 26.22 x 15.04 mm; Jeffreys Bay, beach collected, 1986; Veldsman Collection.

A further 11 specimens were studied that ranges 23-29 mm in size, mostly beach collected or dived at a depth of 20 m, Jeffreys Bay.

Etymology. *Marginella (L.) valae* n. sp. is named for the late Val van der Walt, a well-known shell collector from KwaZulu-Natal. The author spend many hours with her on the

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beaches of Palm Beach and Mzamba learning and identifying beach collected shells in his youth. Many of the specimens used as paratypes for this species were collected by her during the 1980's.

Marginella (Lineamarginella) olearegina
S.G.Veldsman, n. sp.
(Figures 5.1, 5.2, 6.3, 7.5, 8.5 & 8.6)

Description. Shell large (23-38 mm), pyriform shaped, with a rounded shoulder and a slightly pointed lip edge on the posterior end. The posterior notch is slightly developed and has no labial denticles. Callus is slightly developed on the columella. Spire high and moderately broad, spire whorls convex and slightly stepped. Moderately wide protoconch of yellowish-creamy color. Columella rather straight with four continuous plications, which take up half the length of the aperture, light creamy to slightly yellowish color. Aperture narrow, light creamy to yellowish color. Background color of dorsum of the body whorl olive green colored, spars darker blue-grey markings scattered across the dorsum, two broad bands around body whorl, consisting of sparse dark blue-grey markings. Body whorl has thin, blue-grey longitudinal waved lines, consistently carrying on over the shoulder onto the spire. Background color of spire similar to that of the dorsum. Thick labrum, lip straight, creamy to light yellowish background color on both sides, very faint grey markings on dorsal side.

Distribution. Type locality is Jeffreys Bay, South Africa; dredged 80 m. All specimens here were collected at Jeffreys Bay. The species seem to be restricted to deep-water with all specimens collected between 65-100 m.

Type material. The type material of the holotype and paratypes of *M. (L.) olearegina* are as follows:

Holotype: 28.41 x 15.83 mm (Figure 5.1); Jeffreys Bay, dredged 80 m, 2005; Coll. Natal Museum South Africa (NMSA), ID No: P1442/T4401; Donated by S.G.Veldsman.

Paratype 1: 28.13 x 16.02 mm (Figure 5.2); Jeffreys Bay, dredged 80 m, 2006; Veldsman Collection.

Paratype 2: 38.16 x 21.14 mm (Figure 6.3); Jeffreys Bay, dredged 100 m, 2006; Veldsman Collection.

Paratype 3: 28.79 x 16.15 mm (Figure 8.5); Jeffreys Bay, dredged 65-70 m, 2002; Veldsman Collection.

Paratype 4: 29.48 x 16.69 mm (Figure 7.5); Jeffreys Bay, dredged 70 m, 2006; Veldsman Collection.

Paratype 5: 27.05 x 15.25 mm; Jeffreys Bay, dredged 70 m, 2013; Veldsman Collection.

Paratype 6: 27.43 x 15.22 mm (Figure 8.6); Jeffreys Bay, dredged 65-70 m, 2013; Veldsman Collection.

Paratype 7: 26.47 x 15.48 mm; Jeffreys Bay, dredged 70 m, 2013; Veldsman Collection.

Paratype 8: 27.58 x 15.65 mm; Jeffreys Bay, dredged 70 m, 2006; Veldsman Collection.

Paratype 9: 27.30 x 15.51 mm; Jeffreys Bay, dredged 80 m, 2006; Veldsman Collection.

Paratype 10: 27.48 x 15.87 mm; Jeffreys Bay, dredged 80 m, 2006; Veldsman Collection.

A further 40 specimens were studied that ranges from 23-29 mm in size, all dredged between 65-100m, Jeffreys Bay.

Etymology. The name *olearegina* is derived as follows: *'olea'* meaning olive and *'regina'* meaning queen.

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Marginella (Lineamarginella) lauriesmithi
S.G.Veldsman, n. sp.
(Figure 4.3, 6.1, 6.2 & 7.2)

Description. The shell is large (29-36 mm), broad-pyriform shaped, with a sharp rounded shoulder and a pointed lip edge on the posterior end. The posterior notch is slightly developed and has no labial denticles. Callus is slightly developed on the columella. Spire high in height and moderately broad, spire whorls convex and very stepped. Wide protoconch, off-white color to light creamy. Columella rather straight with four continuous plications, which take up half the length of the aperture, off-white to light creamy color. Aperture narrow, off-white to light creamy color. Background color of the dorsum of the body whorl creamy colored, two broad bands around body whorl, consisting of sparse dark brown markings. Body whorl has thin dark brown longitudinal waved lines, widely spaced, consistently carrying on over the shoulder onto the spire. Background color of spire similar to that of the dorsum. Thick labrum, lip straight, creamy background color on dorsal side of edge, no specific markings.

Distribution. Type locality is south-east of Mossel Bay, South Africa; from about 73 m (40 fathoms). This species seems to be restricted to the Agulhas Bank, South Africa.

Type material. The type material of the holotype and paratypes of *M. (L.) lauriesmithi* are as follows:

Holotype: 30.80 x 16.52 mm (Figure 4.3); south-east of Mossel Bay, Agulhas Bank, trawled approximately 73 m (40 fathoms), 1988; Coll. Natal Museum South Africa (NMSA), ID No: E5255/T4398.

Paratype 1: 35.42 x 18.57 mm (Figure 6.1); Betty's Bay, Agulhas Bank, scuba 35 m; Veldsman Collection.

Paratype 2: 29.13 x 16.38 mm; Still Bay, Agulhas Bank, dredged 101 m, 1994; Coll. Natal Museum South Africa (NMSA), ID No: V929/T4399.

Paratype 3: 29.09 x 15.67 mm (Figure 7.2); west of Cape St. Francis, Agulhas Bank, scuba 45 m; Veldsman Collection.

Paratype 4: 35.08 x 19.11 mm (Figure 6.2); Betty's Bay, Agulhas Bank, scuba 35 m; Veldsman Collection.

Paratype 5: 30.37 x 16.13 mm; west of Cape St. Francis, Agulhas Bank, scuba 40 m; Veldsman Collection.

Etymology. *Marginella (L.) lauriesmithi* n. sp. is named for the late Laurie Smith, who was one of the founders of the Pretoria Group of Conchological Society of Southern Africa and chairman for many years. He had a major influence on the author's early years of collecting and researching shells.

DISCUSSION

All the species in the subgenus *Lineamarginella* are characterized by large shells (20-40 mm), broad-pyriform shaped, with rounded shoulders and a sharp pointed posterior lip edge. The posterior notch is slightly developed and specimens have no labial denticles. A callus is slightly developed on the columella. The shell morphology and coloration of all the species distinguished in Table 1. In addition, a few shells in the authors possession cannot be attributed to any of the known species. One shell from Plettenberg Bay, central Agulhas Bank, is similar to *M. hayesi,* apart from the locality difference, the shell is broader and rounder shaped, with color pattern differences

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(*M.* species 1 - Figure 6.4). The unknown species from Mossel Bay is very similar to *M. san,* but it has a broader shape with a sharper edged lip, and color pattern differs (*M.* species 2 - Figure 4.6). These shells maybe described as new species once more material becomes available.

ACKNOWLEDGEMENTS

I thank Sulize Veldsman for proof reading and support during development of this paper. Vellies (J.H.) Veldsman for his input and proofreading; Linda Davis (Natal Museum, South Africa [NMSA]) is thanked for help with the type specimens.

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Editor's Note: *The Festivus* is accepting articles for future issues. Articles of a scientific nature may be submitted for the peer reviewed portion of our journal. Please refer to our Guidelines for Authors, and/or Guidelines for the Description of New Taxa in *The Festivus*, both available on our website: http://www.sandiegoshellclub.com/festivus/.

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Name	***M. lineolata*** (Figure 5.5, 5.6, 7.1, 7.3, 7.4)	***M. olearegina*** (Figure 5.1, 5.2, 6.3, 7.5, 8.5, 8.6)	***M. valae*** (Figure 5.3, 5.4, 8.1, 8.2, 8.3)
Locality	Algoa Bay area, Eastern Cape.	Algoa Bay area, Eastern Cape.	Algoa Bay area, Eastern Cape.
Size (mm)	24-29 mm	23-38 mm	23-36 mm
Shoulder	Rounded shoulder and a slightly pointed lip edge on the posterior end.	Rounded shoulder and a slightly pointed lip edge on the posterior end.	Sharp rounded shoulder and a slightly pointed lip edge on the posterior end.
Spire	Spire short in height and broad, spire whorls convex and slightly stepped.	Spire high in height and moderately broad, spire whorls convex and slightly stepped.	Spire high and broad, spire whorls convex and stepped.
Protoconch	Wide protoconch, light olive to yellowish creamy color.	Moderately wide protoconch, yellowish creamy color.	Wide protoconch, off-white color to light creamy.
Aperture	Aperture wide, off-white color.	Aperture narrow, light creamy to yellowish color.	Aperture wide, off-white to light creamy color.
Labrum	Moderately thick labrum, lip slightly bend to straight, with light bluish grey fine markings on dorsal side of edge.	Thick labrum, lip straight, creamy to light yellowish background color on both sides, very faint grey markings on dorsal side.	Thick labrum, lip slightly bend to straight, creamy background color on dorsal side of edge, no specific markings.
Dorsum and spire coloration	Background color of dorsum of the body whorl a bluish ash color, with here and there a sprinkling of dark shaded spots, and marked with numerous very thin longitudinal waved lines. Background color of spire similar to that of the dorsum.	Background color of dorsum of the body whorl olive green colored, spars darker blue-grey markings scattered across the dorsum, two broad bands around body whorl, consisting of sparse dark blue-grey markings. Body whorl has thin, blue-grey longitudinal waved lines, consistently carrying on over the shoulder onto the spire. Background color of spire similar to that of the dorsum.	Background color of dorsum of the body whorl creamy colored, two broad bands around body whorl, consisting of sparse dark brown markings / spots. Body whorl has vague, very thin, brown longitudinal waved lines, consistently carrying on over the shoulder onto the spire. Spire color similar to dorsum background, off-white with pinkish undertone.

Table 1. Comparison of *Marginella lineolata, M. olearegina,* and *M. valae.*

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Name	*M. san* (Figure 4.4, 4.5, 7.6, 8.4)	*M. hayesi* (Figure 4.1, 6.5, 6.6)	*M. lauriesmithi* (4.3, 6.1, 6.2, 7.2)
Locality	False Bay, western Agulhas Bank.	Agulhas Bank.	Agulhas Bank.
Size (mm)	29-35 mm	32-40 mm	29-36 mm
Shoulder	Rounded shoulder and sharp pointed lip edge on posterior end.	Rounded shoulder and sharp pointed lip edge on posterior end.	Sharp rounded shoulder and a pointed lip edge on the posterior end.
Spire	Spire short in height and broad, spire whorls convex and slightly stepped.	Spire high and moderately broad, spire whorls convex and slightly stepped.	Spire high in height and moderately broad, spire whorls convex and very stepped.
Protoconch	Wide protoconch, off-white color.	Moderately wide protoconch, off-white color.	Wide protoconch, off-white color to light creamy.
Aperture	Aperture wide, off-white color.	Aperture moderately wide, off-white color.	Aperture narrow, off-white to light creamy color.
Labrum	Moderately thick labrum, lip slightly bend to straight, with no markings on edge.	Thick labrum, slightly bend lip, with no markings on edge.	Thick labrum, lip straight, creamy background color on dorsal side of edge, no specific markings.
Dorsum and spire coloration	Background color of dorsum of the body whorl is off-white to a very light yellow, sometimes a very light grey. Two broad bands around body whorl, consisting of broken black to dark brown markings. Body whorl has very thin, light grey longitudinal waved lines, widely spaced, consistently carrying on over the shoulder onto the spire. Background color of spire similar to that of the dorsum.	Background color of dorsum of the body whorl is bluish grey with a tint of light-yellow creamy color. One very broad band around body whorl, consisting of dark grey and blackish way coloration. No fine longitudinal waved lines. Background color of spire similar to that of the dorsum, no fine wavy lines.	Background color of dorsum of the body whorl creamy colored, two broad bands around body whorl, consisting of sparse dark brown markings. Body whorl has thin dark brown longitudinal waved lines, widely spaced, consistently carrying on over the shoulder onto the spire. Background color of spire similar to that of the dorsum.

Table 2. Comparison of *Marginella san, M. hayesi,* and *M. lauriesmithi*.

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Figure 4. **1**= *M. hayesi* (39.90 x 21.14 mm) – Holotype; Betty's Bay, scuba 30 m; Coll. Natal Museum South Africa (NMSA), ID No: V58/T1029. **2**= *M. lineofasciata* (31.80 x 17.80 mm) – Holotype; East London, scuba 18-25m; Coll. Natal Museum South Africa (NMSA), ID No: S9077/T866. **3**= *M. lauriesmithi* (30.80 x 16.52 mm) – Holotype; south-east of Mossel Bay, trawled 40 fathoms (approx. 73 m), 1988; Coll. Natal Museum South Africa (NMSA), ID No: E5255/T4398. **4**= *M. san* (32.16 x 18.73 mm) – Paratype 5; Buffels Bay (Cape Point), False Bay, scuba 15 m; Veldsman Collection. **5**= *M. san* (34.82 x 19.94 mm) – Paratype 1; False Bay, scuba 10m; Veldsman Collection. **6**= *M.* species 2 (34.78 x 19.96 mm); Mossel Bay, scuba; Veldsman Collection.

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Figure 5. **1=** *M. olearegina* (28.41 x 15.83 mm) – Holotype; Jeffreys Bay, dredged 80m; Coll. Natal Museum South Africa (NMSA), ID No: P1442/T4401. **2=** *M. olearegina* (28.13 x 16.02 mm) – Paratype 1; Jeffreys Bay, dredged 80m; Veldsman Collection. **3=** *M. valae* (32.74 x 18.58 mm) – Holotype; Jeffreys Bay, beach collected; Coll. Natal Museum South Africa (NMSA), ID No: P1441/T4400. **4=** *M. valae* (30.46 x 17.01 mm) – Paratype 1; Jeffreys Bay, beach collected; Veldsman Collection. **5=** *M. lineolata* (26.10 x 15.83 mm); Algoa Bay, scuba; Veldsman Collection. **6=** *M. lineolata* (23.43 x 14.55 mm); Port Elizabeth, scuba; Veldsman Collection.

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Figure 6. **1=** *M. laurismithi* (35.42 x 18.57 mm) – Paratype 1; Betty's Bay, scuba 35m; Veldsman Collection. **2=** *M. laurismithi* (35.08 x 19.11 mm) – Paratype 4; Betty's Bay, scuba 35m; Veldsman Collection. **3=** *M. olearegina* (38.16 x 21.14 mm) – Paratype 2; Jeffreys Bay, dredged 100 m; Veldsman Collection. **4=** *M.* species 1 (35.43 x 19.54 mm); Plettenberg Bay, 60-80 fathoms (Approx. 109-146 m); Veldsman Collection. **5=** *M. hayesi* (32.56 x 17.75 mm); Betty's Bay, scuba 40 m; Veldsman Collection. **6=** *M. hayesi* (34.34 x 19.44 mm); Danger Point, scuba 45 m; Veldsman Collection.

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Figure 7. **1**= *M. lineolata* (27.15 x 15.48 mm); Jeffreys Bay, dredged 75m; Veldsman Collection. **2**= *M. lauriesmithi* (29.09 x 15.67 mm) – Paratype 3; west of Cape St. Francis, scuba 45m; Veldsman Collection. **3**= *M. lineolata* (27.51 x 16.72 mm); Jeffreys Bay, scuba 20m; Veldsman Collection. **4**= *M. lineolata* (26.60 x 16.14 mm); Jeffreys Bay, dredged 75m; Veldsman Collection. **5**= *M. olearegina* (29.48 x 16.69 mm) – Paratype 4; Jeffreys Bay, dredged 70 m; Veldsman Collection. **6**= *M. san* (32.21 x 19.28 mm); Sunny Cove, False Bay, scuba 10 m; Veldsman Collection.

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Figure 8. **1**= *M. valae* (30.78 x 17.79 mm) – Paratype 2; Jeffreys Bay, beach collected; Veldsman Collection. **2**= *M. valae* (31.90 x 18.74 mm) – Paratype 5; Jeffreys Bay, beach collected; Veldsman Collection. **3**= *M. valae* (27.27 x 15.79 mm) – Paratype 4; Jeffreys Bay, beach collected; Veldsman Collection. **4**= *M. san* (35.43 x 19.54 mm) – Paratype 2; Fish Hoek, False Bay; Veldsman Collection. **5**= *M. olearegina* (28.79 x 16.15 mm) – Paratype 3; Jeffreys Bay, dredged 65-70 m; Veldsman Collection. **6**= *M. olearegina* (27.43 x 15.22 mm) – Paratype 6; Jeffreys Bay, dredged 65-70 m; Veldsman Collection.

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Investigation into the identity of the taxon *Callipara (Festilyria) festiva*, with the description of two new species

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ABSTRACT The history of the taxon *Callipara (Festilyria) festiva* is carefully reviewed, and new light is shed on the existence of other members of this 'group', described hereunder as *Callipara casaana* sp. nov., and *Callipara victoriae* sp. nov.

KEYWORDS Masirah Island, Oman, Socotra Island, Somalia, Yemen, *Callipara, Festilyria, C. festiva, C. deceptrix, C. dobsonae, C. lizzae, C. casaana, C. victoriae*

INTRODUCTION

The first author has been fortunate to spend a considerable amount of time studying shells on Masirah Island, and elsewhere in Oman. A recent connection with him and the second author has resulted in an in-depth investigation into the mysterious journey taken by the species *Voluta festiva* from its inception in 1811 until the present.

What is firstly clear is the consistent difference noticed between the large knobbly red protoconch of the 'Somali *festiva*', and the smaller, narrower, pale protoconch of the 'Masirah *festiva*'. The second author is convinced, secondly, of the logic proposed by the first author, *i.e.* that the syntype specimen of Lamarck's shell (Plate 1 figure 1), held in Paris, is in fact virtually certainly a specimen from around Masirah Island, Oman.

A chronology of this initially extremely rare, beautiful and elusive species is fascinating, as elucidated below:
Named by Lamarck as a new species in 1811, on page 73 of "Annales du Museum d'Histoire Naturelle, 1811, the description was apparently based on a single shell, suggested tentatively as being from the waters around South America, whose size, shape and patterning corresponds well to the shells that are found today in Omani waters. The original Latin description can be summarized as:
"40. The decorated Volute. *Voluta festiva.* Volute with central swelling, spindle-shaped, ribbed, flesh-coloured, with golden blotches; small light brown wavy vertical lines, scattered, and banded. Columella has three folds."

There then follows a further description in French, summarized as follows:
"Museum # 43. Habitat…. probably the seas of South America. A very beautiful and very rare shell, which is similar in its description to *Voluta magellanica* Lamarck, 1811, but which is very distinct and more ornate. It is plump, spindle shaped, with longitudinal ribs well defined on the teleoconch, less strongly present in the lower half of the last whorl. On a flesh-coloured background, clouded with a few fawn-brown spots, it has vertical red-brown wavy lines, arranged in transverse zones, and spots or droplets of the same colour, spread apart, arranged in similarly transverse cords. The base

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of its columella is adorned with three tight folds, the top-most of which is the least well-defined. Length, 71 millimetres."

Note that the referenced species *Voluta magellanica* Lamarck, 1811 alluded to above is now represented as *Adelomelon ancilla* (Lightfoot, 1786).

In his initial personal notes, the first author makes the following telling comment, and proposal: "My reading of this is that the description refers to the Arabian shells that we find in Oman, and does not reflect the strong orange-red colouring found on the teleoconch of the Somali collected shells, nor their much larger size. I would propose a *nomen novum* of *Callipara casaana* (from the Somali word for "red") for the big, and very distinct, east African shells, and that the name *Callipara festiva* is retained for those shells exhibiting the characteristics described by Lamarck in 1811, as found off the coastlines of Masirah Island and south eastern Arabia. A summary of ~200+ *Callipara festiva* beached shells found and measured by ourselves from various sites in Oman over several years reveals the following statistics, excluding obvious juveniles less than 20 mm."

Other historical findings indicate that a maximum size closer to 135 mm or even more may be achievable, though none have been recorded in recent years in Oman.

Minimum size, 42.1 mm; Maximum size 126.6 mm; Mean (average) size 78.9 mm.

G.B. Sowerby II, in his 1847 Thesaurus Conchyliorum Vol. 1, pp 218-219 and Plate 52, illustrates what is purported to be Lamarck's shell, still unique, noting that the drawing is from 'an earlier time' (Figure 1).

Maxwell Smith, in 1942, covers some earlier references, giving shell size as 100 mm - 125 mm, found from south-east Africa, Natal coast (Sowerby) and states "said to be one of the rarest volutes."

In 1954, Pilsbury & Olssen introduce the Genus '*Festi-lyria*,' specifically for the shells known as *festiva*.

In 1959, K. H. Barnard, in the Annals of the SA Museum, # 45, states the locality data by Sowerby 1897 'Natal coast' is probably incorrect.

In 1968, Cliff Weaver illustrates the type specimen of *festiva* in black and white, in his description of *Festilyria duponti*.

Figure 1. Composite extract of the 71 mm shell from Plate 52, Thesaurus conchyliorum Volume 1, 1847, G.B. Sowerby II.

Peter Dance in his famous 1969 book Rare Shells (50), illustrates a broad, knobbly shell from the Hugh Cuming collection, (BMNH), at 137 mm x 80 mm, from "S. E. Africa". His

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comments in 1969 are "most known examples, perhaps a dozen or so, are more or less worn and faded", and further on: "only 3 or 4 are known to have been trawled during the present century". His may be the first colour photo of the presumed new species described in this paper.

In 1970, Don Aiken illustrated *festiva* (Figure 2) from "a painting by G. L. Wilkins, (kind permission Mrs. Helen Boswell)", in his book co-authored with friend Ken Fuller. Don's lovely ink-drawn image is almost certainly a copy of Maxwell Smith's 1942 illustration of *festiva*.

Weaver and du Pont in 1970 maintain the aura of mystery surrounding the species, firstly by stating that the type locality is restricted to Al Masirah Island, based on a specimen given to Donald Bosch in 1960 from there, and secondly by saying it is only known from the type locality. Their colour image of the 135 mm x 68 mm shell is of a very dead specimen judging by the lack of dorsal pattern, and may very well be the specimen illustrated by Smith and Aiken.

In HSN Vol XXI No 12 of December 1973, a snippet by Elmer G. Leehman with an interesting black & white image is presented of a "*Voluta festiva*" found off Aden, South Arabia, trawled from "more than 200 fathoms". This equates to a depth of 365 metres, or 1,200 ft! The portrayed shell, with some slight, typical damage low on the lip, looks to have been polished, as it became known later on that the species has a matt looking dorsum. Thankfully, the shell is photographed next to a 'foot rule', showing a size of around 178 mm, and not the 108 mm as stated. This is a classic representation of the "intermediate" ('*deceptrix*') found between Somalia and Oman.

In a further addition to this "*festiva* pot of mystery" (and confusion), a fascinating article appeared in HSN Vol XXVI No12 of December 1978, entitled "A Breakthrough in Volutes" by Cliff Weaver, wherein he firstly refers to dead shells found in the Arabian Peninsula…"all presumed to represent females", and secondly, illustrates a very unusual specimen that he calls *festiva*, dived live by Roy Richardson in shallow (10 m) water off Masirah Island, which we can, for the time being, call "Richardson's volute"…. He compares this utterly different shell with a "Bledsoe" shell he calls a 'typical' female *festiva*, and tellingly, says "the new shell differs strikingly from Bledsoe's". The 'Bledsoe volute' from the Gulf of Aden at 50-60 metres is a sure candidate for the next "festiva moment", when Palazzi, in 1981, describes *Festilyria festiva deceptrix*. This is a much narrower, smaller (than a lot of the Somali shells), more ribbed shell, which he separates from the increasingly better known, very large, knobbly Somali specimens.

Figure 2. Ink drawing by Don Aiken, 1970

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In HSN of November 1979, South African W.E.J. Walles proposes using specific shell ratios as a potential means to separate species, and addresses Weaver's contention of dimorphism by potentially showing 'Richardson's volute' as a different shell completely.

In 1980, a really valuable, and pertinent (to this paper), article appeared in HSN Vol XXVII No 8 of August 1980. Herein, Sadao Kosuge and Koji Nomoto present a contrary opinion to the theory of Cliff Weaver, and put forward a convincing argument that shells of *festiva*, male and female, are in fact similar. This is based on an extremely rare opportunity to actually dissect three animals, and they tactfully propose that "Weaver's suggestion of sexual dimorphism in *festiva* would seem to require further investigation".

Figure 3. 14.1 mm juvenile *C. festiva* collected in Dhofar Governorate, Oman. Coll. A.R.R. Childs #100931

Aiken and Fuller produce a second edition of their Volutes of Africa (1986), and add this interesting comment: "Distribution: Originally found off the Arabian Peninsula in 1960 but much more recently collected off the coast of Mozambique and on the beach."

In Rossiniana #37 of October 1987, a valuable piece of information surfaces. Allan Limpus produces a well-researched chronology of this species, pointing out the continuing confusion regarding this elusive beauty at the time. He illustrates a stunning specimen of the so-called *deceptrix*, true to form… narrow, ribbed, medium size, and mentions Palazzi's comment "that more research has to be done to ascertain with sufficient precision the limits of variability of the single species". As Limpus indicates, his 123 mm shell had been live trawled in 125 metres of water, south-west of Socotra Island off south Yemen, and then points out, alluding to the then crazy rarity of Somali shells… "I do not have a *festiva* in my collection for comparison…" The above solid data is important for the considerations further on in this paper. It is here noted that the distance between the area south-west of Socotra and Masirah is around 1,200 km.

An exact copy of the above article is to be found in The Strandloper, Bulletin of The Conchological Society of Southern Africa, number 221, page 8, of July/September 1987, illustrating this beautiful 123mm shell.

In World Shells 1992, the third author presents lovely images of *festiva*, covering a superb very large knobbly shell, a stunning predominantly red coloured juvenile and a '*deceptrix*', the narrower form that he considers "a mere synonym without a taxonomic value."

Some interesting information is found in Poppe and Goto's 1992 VOLUTES. Firstly, they state the range as being from Adula, Somalia, to Al Masirah, Oman. Secondly, they state that the red colouration of early whorls separates *festiva* from *C. africana*, and thirdly, they confirm a valuable, rare piece of information regarding the animal, which Kosuge & Nomoto described as "pale red with round and oval black-brown

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Figure 4. A selection of typical colour patterns of *C. festiva* from Masirah island, Oman, 43.1 mm – 119.4 mm. Coll. A.R.R. Childs

spots". This is utterly different from animal colours described for 'Richardson's volute", described here as *C. victoriae sp. nov.* See description herein below for animal colour(s).

In 1995 the plot thickens completely, where, on page 142 of Donald Bosch *et al.,* in Seashells of Eastern Arabia, he illustrates some marvellous examples of Masirah volutes, including illustrations of two (or perhaps more) amazing very different volutes that bear striking similarity to 'Richardson's' shell, and interestingly distinct *festiva* colour variations.

In World Shells of 1996, Igor Bondarev does some really penetrative work, and poses many taxonomic questions regarding *Callipara, Festilyria* and *festiva*, and interestingly, brings *Harpulina* into this already complicated picture, and for good reason. He is well aware of 'Richardson's volute', and is onto something when he alludes to the fact that such shell has morphological affinities with *Harpulina loroisi / lapponica*, which of course exist in the Indian ocean, off India and Sri Lanka, not too far east of Masirah. His sketch of the zones of occurrence of *Callipara, Festilyria* and *Harpulina* is interesting, indeed.

In the 1997 La Conchiglia Yearbook, the richly illustrated Volutes of the Doute Collection present a spectacular very red 210 mm specimen from "off Somalia", and four others from the same locality.

In 2002/3, the third author produced a Taxonomy of Recent Volutidae, presenting Festilyria as a subgenus under *Callipara*, with *festiva, duponti* and *ponsonbyi* as members.

In the Iconography, The Tribe *Lyriini*, by Bail and Poppe in 2004, *festiva* is presented as a large, knobbly species with "apparently rather extensive range, from Arabian coasts down to North Mozambique". In their remarks, they state that "This species has few variants", adding that they considered that *festiva deceptrix* is merely a variant. It must be assumed, that as recently as 2004, precious little was still known or recognized of the Arabian

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population, which we can finally bring into full focus in this paper. We would agree that *festiva var. deceptrix* is indeed one of the colour variants of the true *C. festiva* as described by Lamarck in 1811.

In 2005, in Strandloper 276, the second author and Alwyn Marais present the Tribe *Lyriini* from the East coast of Africa, also illustrating the broad, knobbed shell and narrower *deceptrix*. The actual enigma remained until the introduction of multiple specimens, where finally, we are able to demonstrate continuous and separable morphology and colour, bringing us to the purpose of this paper where a description (account) of species is presented.

ABBREVIATIONS

AMNH	American Museum of Natural History, New York
BMNH	British Museum of Natural History, London
HSN	Hawaiian Shell News
NMR	Natural History Museum, Rotterdam
NMW	National Museum Wales (Amgueddfa Cymru), Cardiff
sp. nov.	Species nova – new species
var. nov.	Variant nova – new variant
Coll.	Collection

SYSTEMATICS

Family Volutidae, Rafinesque,1815
Subfamily Volutinae, Rafinesque, 1815
Tribe Lyriini, Pilsbry and Olssen, 1954
Genus *Callipara*, Grey, 1847
Subgenus *Festilyria*, Pilsbry and Olssen, 1954.

Callipara (Festilyria) festiva
Lamarck, 1811
(Figure 5, Plate 1 Figures 1-3)

Shells volute-like, with consistent narrow profile, protoconch and teleoconch whorls pale coloured. Low axially continuous ribs cover the whorl to the shoulder. Average size (200+ specimens), 78.3 mm, ranging from 42.1 mm to 120.6 mm. May grow to in excess of 135 mm. Background colour pale salmon to flesh-coloured. Pattern of radial rows of thin, dark axial lines, sometimes with a distinct central band of darker colour. Random patches of brown colour on the dorsum. Shells often have ~5 rows of distinctive pale radial dashes.

Figure 5. Typical colouration of *C. festiva* from Masirah Island and off the shores of the Al Wusta Governorate of Oman, 75.8 mm. Coll. A.R.R. Childs

Distribution. Off the coastlines of Masirah Island and elsewhere, in the south-eastern Arabian country of Oman; mainly beach-collected to date, alluding to a shallow water habitat.

Comments. As has become clear, this more recent 'discovery' is with little doubt the true

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representation of "*Festilyria festiva*". Images presented in this paper confirm the theory that the original specimen used by Lamarck for his (historical) description, is a shell from the area of Oman, and close to fully adult, not a juvenile as assumed by Weaver.

A fantastic dark variant of *C. festiva* is found in Dhofar, southern Oman by V. Dobson in October 2016 … enhancing those radial dashes … "Dobson's festiva" is currently the only known example of this rare colour form C. *festiva var. dobsonae* var. nov. (Plate 1 Figure 4). This colour form is not found further north in Oman.

Figure 6. *C. festiva var.lizzae* var. nov. (also known as the "Type-2" of some authors). Image courtesy of Sergey Rusov.

The Masirah Island population is the primary location for the *C. festiva*. Of the shells found there, approximately 2% of those collected show a strikingly different and stronger colour. This is shown centre left of p.142 in Seashells of Eastern Arabia, 1995. Originally considered just to be a "fresher" specimen, this is now considered to be a much less common, but distinct, colour variant – *C. festiva var. lizzae* var. nov. (Figure 6, Plate 2 Figures 1-2), also known as the "Type-2" of some authors and is named for the grand-daughter of the first author.

Etymology. Festiva = excellent (from the Latin) … the decorated Volute.

Callipara (Festilyria) casaana Childs, Aiken & Bail, sp. nov.
(Figure 7, Plate 2 Figures 3-4. Plate 3 Figure 3)

Description. Shells extremely large (even for most volutidae), reaching 250 mm, with very broad profile. Protoconch and teleoconch whorls deep orange–red coloured. Whorls with low ribs, terminating in large shoulder knobs, aperture broad, salmon-pink internally. Radial pattern often with groups of thin, dark and narrow closely-spaced axial lines, terminating in black markings on the labral edge in specimens without filed lips. Base of columella marked with black. Kosuge & Nomoto describe the animal as "pale red with round and oval black-brown spots".

Figure 7. *Callipara (Festilyria) casaana* sp. nov. Holotype 208 mm, in NMR Rotterdam 9930_53402. Image courtesy of Frans Slieker, NMR.

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Types. Holotype *Callipara (Festilyria) casaana* sp. nov., 208 mm, deep water off the coast of Somalia. Collection NMR Rotterdam 9930_53402.

Distribution. Trawled in fairly deep water off the coast of Somalia.

Comments. Touted as *Festilyria festiva* for years, this species is consistently different from its Arabian congener, and therefore needs a separate taxon name. Reportedly collected only from trawler operations, this would allude to a deeper water habitat. A highly pertinent piece of discriminatory information is the animal description above, which is radically different from that reported for *Callipara victoriae* sp. nov.

Etymology. Casaana, meaning "red" in the local Somali language.

Callipara (Festilyria) victoriae Childs, Aiken & Bail, sp. nov.
(Figures 8-9, Plate 3, Figures 1-2)

Description. Shells fairly light, profile ovate, shoulder smooth and rounded, protoconch bulbous, shell size around 85 mm. Whorls with low, indistinct shoulder knobs, becoming virtually obsolete on the final whorl. Columella concave, with two or three discernible pleats, anteriorly placed. Outer lip appears bevelled. Background colour cream, overlaid by a series of thin dark radial lines in parallel, between which are rows of thin, brown axial markings, terminating at the edge of the lip as dark marks. (This is a feature that is seen in a number of members of the tribe *Lyriini*, termed by the second author as "Lyria lines"). Base of columella marked with a dark blotch. In the only live-taken specimen, (known as "Richardson's volute"), living features were recorded as: "the foot and body of the animal were smokey-yellow, with green markings all over".

Figure 8. Holotype specimen of *Callipara (Festilyria) victoriae* sp. nov. 84 mm, AMNH 245760. Image courtesy of American Museum of Natural History.

Types. Holotype *Callipara (Festilyria) victoriae* sp. nov., 84 mm, Masirah Island, Oman. Collection AMNH #245760.

Distribution. Only known from a specific location on Masirah Island, Oman.

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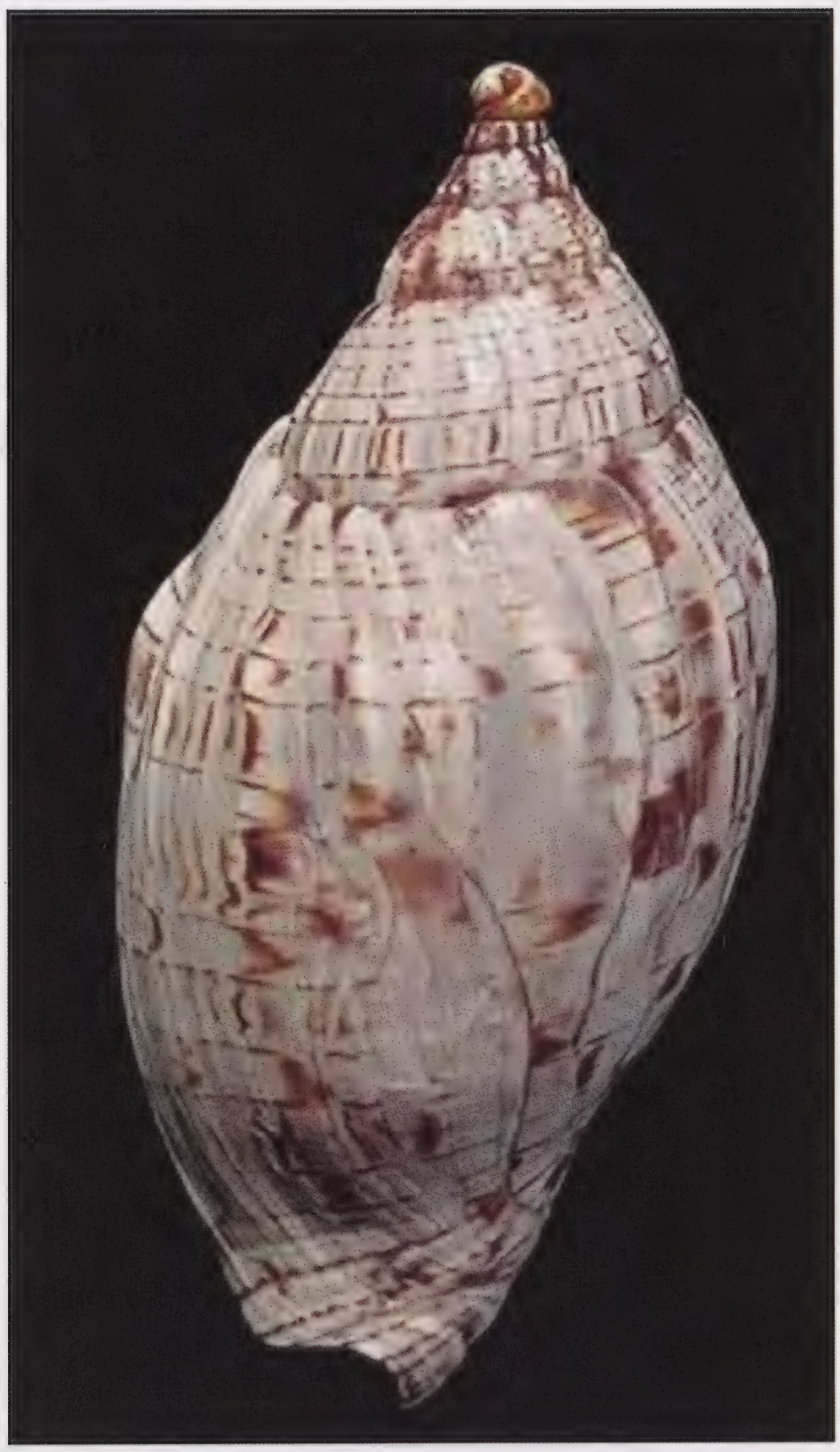

Figure 9. 84.5 mm specimen of *Callipara (Festilyria) victoriae* sp. nov. collected in the late 1970s. Image courtesy of Robert Schoeller, USA.

Comments. The first author has spent much time tracking down examples of this very rare species. To date, only around a dozen specimens are known.

National Museum Wales ex M. Day Collection; three shells, two adult, one juvenile, held under references NMW.Z.1993.055.04 and NMW.Z. 1995.002.131.

Three shells in the American museum of Natural History, under reference AMNH 245760.

HSN, "Richardson's Volute". One shell on display at the Masira Island Resort hotel.

Two (or possibly more) shells in Bosch Book, Page 142.

One worn shell collected August 2020 by Leslie and David Bosch.

Over time, there has been a paucity of information on its existence, which is brought together here. Although clearly a *Lyria*, it is morphologically fascinating and different, with its ovoid 'plump' shape and shorter spire. The instinctive work of Bondarev (and Poppe perhaps), pointed to a relationship with the Genus *Harpulina*, found not too far east of Masirah, creating the idea that *C. victoriae* forms a link to *Harpulina*, but can also be compared with what is possibly its closest '*Lyria*' congener, *L. mallicki jessicae*, … plump, straw yellow background with thin radial lines.

Etymology. Named for the partner of the first author, who has done much collecting with him.

Callipara (Festilyria) festiva
var. deceptrix Palazzi, 1981
(Plate 3, Figure 3, Plate 4)

Description. Shells narrow, morphologically similar to the true Masirah *festiva*, but much larger. The size averages 175 mm, with a high spire, coloured red, with continuous, low axial ribs.

Distribution. Dredged from the channels south-west of Socotra Island and around the coast of Somalia.

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Comments. The first author has proposed that in '*deceptrix*', there may be found a link between the large broad Somali *casaana*, and the small, narrow Masirah *festiva*, as it has inherited the strong orange/red colouration and larger adult size seen in *casaana*. Certainly, the few more reliable references to this form are that it is found in 60 to 95 metres of water somewhere "off Yemen", which does put it firmly between *casaana* and *festiva*.

Palazzi's description of *deceptrix* in 1981 was clearly based on a comparison with the Somali species we have named herein as *C. casaana*. It appears that he did not reference examples from Oman, and seems to have missed a comparison with the Lamarck type entirely. Like us, he observed morphological and size differences, but in a very limited sample size. The shape and form of "Yemen" specimens bear a similarity to Omani *festiva*, but with the red teleoconch whorls. At 150 to 200 mm in length, they deviate significantly from the shorter *festiva*, but we feel it is prudent at this point to maintain it as a mere colour variant, under the true *festiva*. Further research may point to some hybridisation, with the *C. casaana* parentage providing genes that introduce the red colouration and larger size.

CONCLUSION

- *Callipara (Festilyria) festiva* as described by Lamarck in 1811 is only known from Oman.

- *Callipara casaana* sp. nov. has been misidentified as *Callipara (Festilyria) festiva* from the first reporting of these shells, thought to be in the 1960s.

- *Callipara victoriae* sp. nov. is a different species from *Callipara (Festilyria) festiva*.

In addition to the common pale colouration found on Masirah Island, *Callipara festiva* exhibits three additional distinct colour form variants.

Callipara festiva var. deceptrix is only found off the coasts of Somalia and Djibouti, and is the best-known colour variant of the true *Callipara (Festilyria) festiva*. It is not a separate *Callipara* species, nor is it a form or subspecies of *Callipara casaana* sp. nov. Further research is, however, required to confirm whether there is any hybridisation parentage here.

In addition, two other colour forms of *Callipara festiva* are described in this paper by the first author. These are *C. festiva var. dobsonae* from Dhofar, and *C. festiva var. lizzae* from Masirah Island, Oman.

ACKNOWLEDGEMENTS

Thanks are due to M. Scali and V. Liverani for proposing to the first author that he should investigate this conundrum. Also thanks to David and Leslie Bosch for their support and the provision of additional sizing data and photographs of a considerable collection of *C. festiva* found on Masirah Island in Oman, which supported the theories put forward in this paper.

S. Rusov kindly provided photographs of the darker Masirah Island variant previously known merely as "Type-2", here named as *C. festiva var. lizzae.*

We would be remiss to omit V. Dobson who provided encouragement and was an unfailing shelling partner, who also found many specimen shells that were measured, photographed and studied to produce this paper. The naming of *C. festiva var. dobsonae* is a tribute to this.

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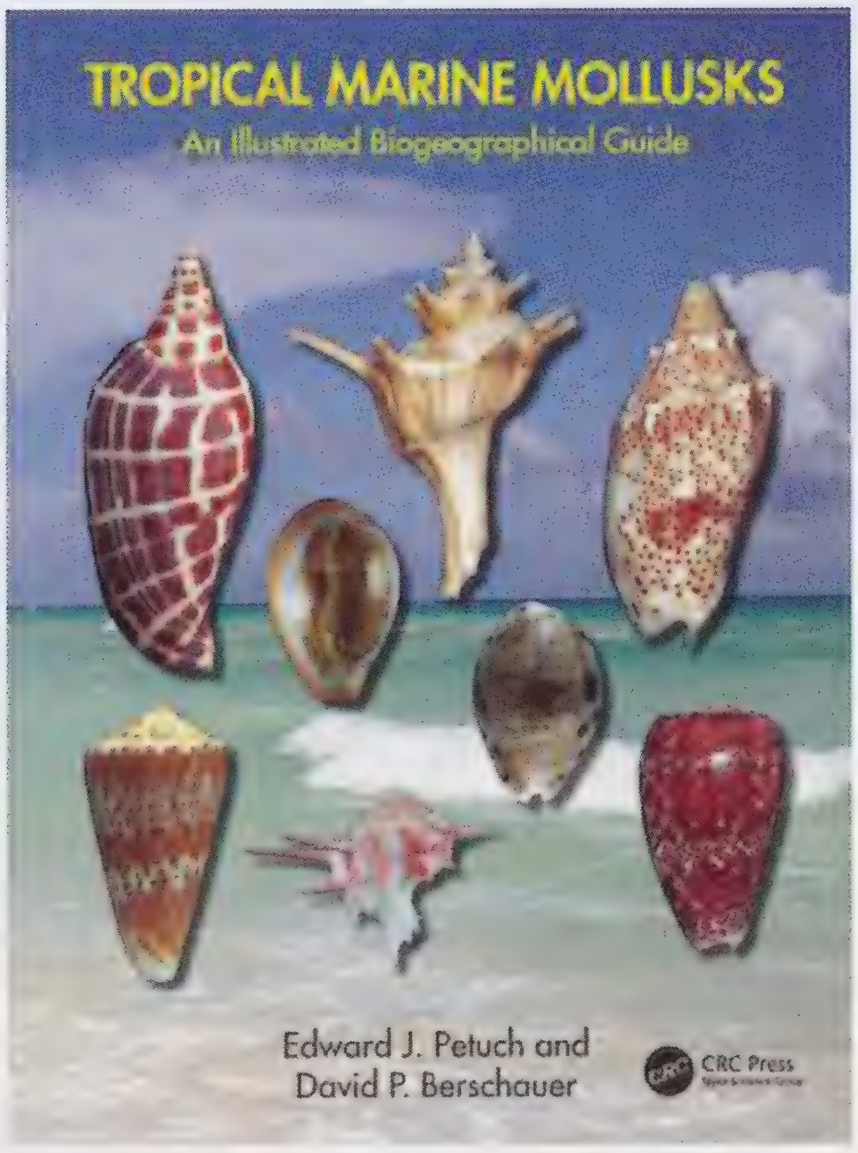

Tropical Marine Mollusks - An Illustrated Biogeographical Guide *CRC Press - December 2020*

Marine biogeography, the study of the spatial distribution of organisms in the world's oceans, is one of the most fascinating branches of oceanography. This book continues the pioneering research into the distributions of molluscan faunas, first studied by biologists over 160 years ago. It illustrates 1,778 species of gastropods in full color, many of which are extremely rare and poorly known endemic species that are illustrated for the first time outside of their original descriptions.

The spatial arrangements of malacofaunas shown in this book can be considered proxies for worldwide oceanic conditions and used as tools for determining patterns of Global Climate Change. The book's documentation of evolutionary "hot spots" and geographically restricted endemic faunas can also be used as a base line for future studies on patterns of environmental deterioration and extinction in the marine biosphere.

Documenting the evolution of the amazingly rich worldwide gastropod fauna, this book will appeal to physical and chemical oceanographers, systematic and evolutionary biologists, historical geologists, paleontologists, climatologists, geomorphologists, and physical geographers. The authors incorporate aspects of all of these disciplines into a new classification system for the nomenclature of biogeographical spatial units found in tropical, subtropical, and warm temperate seas.

Black Friday sale 30% off (November 26th to December 2nd)

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Plate 1. 1. *Callipara (Festilyria) festiva* syntype. Image courtesy MNHN, France. 70.7 mm. **2.** Typical colouration of *C. festiva* found on Masirah island and off the shores of the Al Wusta Governorate of Oman. Coll. A.R.R. Childs #102841. **3.** 81.5 mm *C. festiva* from Masirah Island. Coll. P. Bail. **4.** *C. festiva var. dobsonae* from Dhofar, Oman, 76.0 mm. Coll. A.R.R. Childs #101451.

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Plate 2. 1. *Callipara (Festilyria) festiva var. lizzae* (85 mm) Image courtesy of David and Leslie Bosch. **2.** *Callipara (Festilyria) festiva var. lizzae* (102 mm) Image courtesy of David and Leslie Bosch. **3.** *C. casaana sp. nov.* (208 mm), Coll. NMR Rotterdam 9930_53402. Image courtesy of Frans Slieker, NMR **4.** *C. casaana* shells found off Somalia. (205 mm), Coll. P. Bail.

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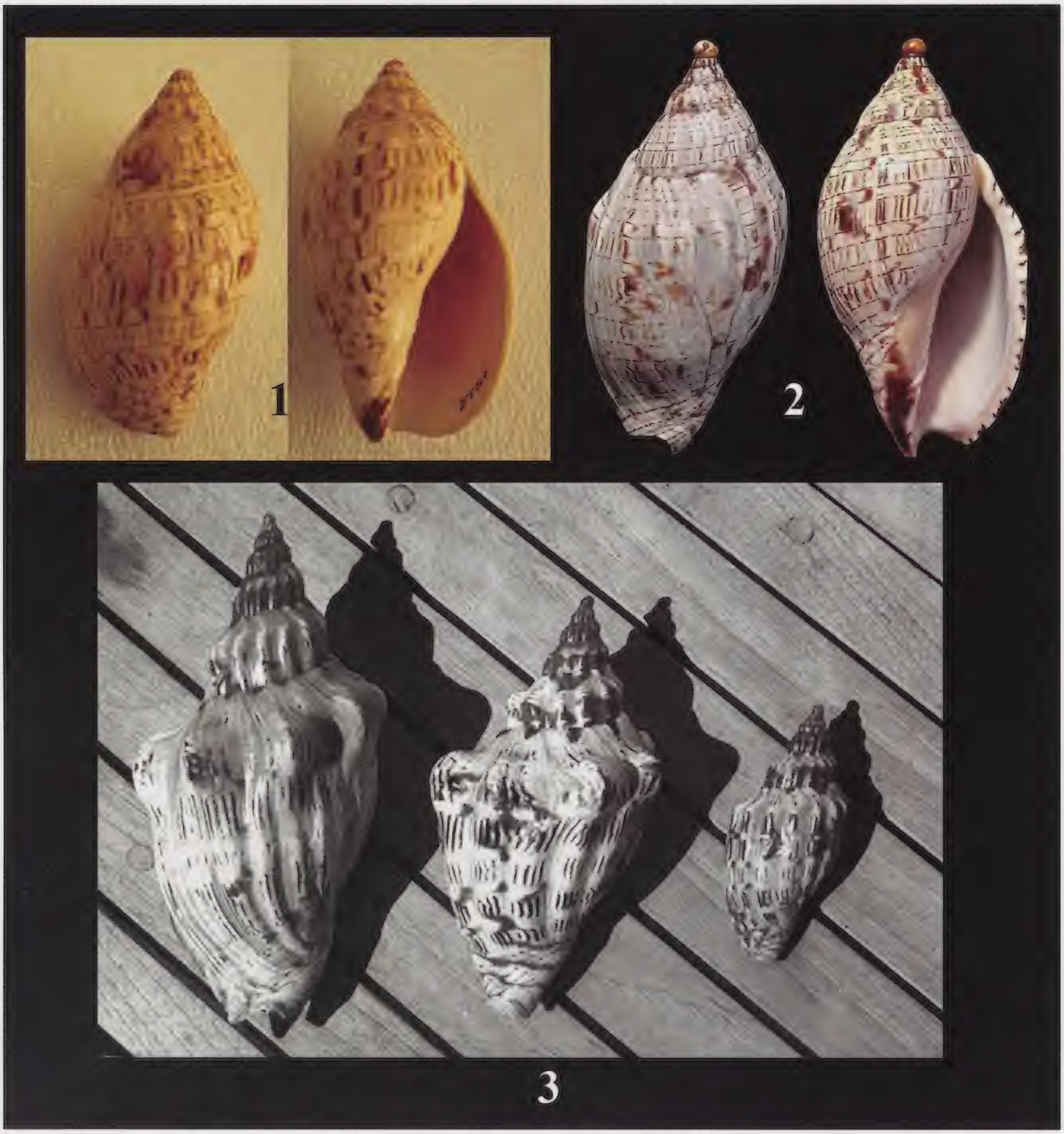

Plate 3. 1. Callipara (Festilyria) victoriae sp.nov. (84 mm), Holotype, Coll. AMNH 245760. Image courtesy of AMNH. **2.** *Callipara (Festilyria) victoriae sp.nov.* (84.5 mm), Image courtesy of Robert Schoeller, USA. **3.** A comparative photo of the slim *C. festiva var. deceptrix* alongside two much larger *C. casaana.* This photo was taken after a shelling trip off the coast of Djibouti. Image by P. Bail.

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Plate 4. Holotype shell of *Callipara festiva var.deceptrix* Palazzi, 1981, (116 mm), Southern Somalia, collected by G. Lugli. Coll. Museo Civico di Storia Naturale di Milano.

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Volume: 52 THE FESTIVUS ISSUE 4

Have a shell collection you would like to donate to The San Diego Shell Club?

The San Diego Shell Club is interested in your shell collection. As a 501c(3) organization, all donations to our Club may provide a tax write-off. When we receive a donation we provide a letter describing the items that may be used when filing your taxes. While we cannot provide a value, donations of up to $5,000 do not require a written appraisal. Since tax laws change regularly we recommend that you check with your tax accountant before relying on any information provided here.

We are interested in all types of shells, marine or land and all genera and species, including books on shells as well as items related to shells such as artwork, storage cases and tools. Your donated items will be used to generate income to support the Club's efforts in continuing Public education about shells and conservation of marine life throughout the world. If you would like to donate, please contact David Waller, SDSC Acquisition Chairperson, at dwaller@dbwipmg.com to schedule a time to discuss charitable gifting.

CLUB NEWS

2020 August - West Coast Shell Show

Canceled due to the COVID19 pandemic.

2020 September - General Meeting

Canceled due to the COVID19 pandemic. David Berschauer gave a video presentation on August 22nd on *Murexiella* species from the Carolinean and Caribbean Provinces, which was live streamed on Facebook ® by Dung Vo.

2020 October General Meeting

Canceled due to the COVID19 pandemic. Phil Liff-Grieff gave a video presentation on October 24th on Zoom ® hosted by Dung Vo, entitled: Land Snails in Israel: A Snail Collector's Perspective or How Do They Snails Live in the Desert?

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Volume: 52 THE FESTIVUS ISSUE 4

Editor's Corner - dissenting opinions and science "wars"

David P. Berschauer, Editor
shellcollection@hotmail.com

As previously indicated once an author's article has been peer reviewed and published that does not necessarily mean that other scientists in the same field agree with the author's hypotheses, analysis or conclusions. Differences of opinion are common in science and occasionally other professionals take the time to research and write an appropriate rebuttal paper with their hypotheses, the results of their research, and their conclusions. Such "dissenting opinions" should be firmly grounded in science and should be the result of the rebuttal author's independent research, which should be conducted with the same degree of scientific effort and diligence as the original authors put forth, followed by the peer review process and publication. In a perfect world, dominant paradigms, research grant funding, egos, personality disputes, and emotions would not come into play. Unfortunately, we do not live in a perfect world and scientists are just people. More often than not long standing favored hypotheses (or paradigms) become so firmly entrenched that anyone who challenges it or proposes a competing hypothesis is ostracized by his/her peers. Further, and unfortunately, personal dislikes and vendettas find their way into the published scientific literature.

One fairly recent example was the hypothesis that a large asteroid struck the coast of southeastern North America causing mega tsunamis, major destruction of habitats, and scouring of the sea floor down to the bedrock. (Petuch, E.J., 1987, The Florida Everglades: a buried pseudoatoll? Journal of Coastal Research 3(2):189–200.) This hypothesis was widely scoffed at, subjecting the author to lasting professional ridicule. A decade later other scientists found evidence to support this hypothesis and the asteroid impact was accepted. (The Chesapeake Bay Bolide Impact: A New View of Coastal Plain Evolution. US Geological Survey Fact Sheet 049-98, 1998; Powars, D.S. and Bruce, T.S., 1999, The effects of the Chesapeake Bay impact crater on the geological framework and correlation of hydrogeologic units of the Lower York-James Peninsula, VA, U.S. Geological Survey Professional Paper 1612, U.S. Geological Survey, 82 pp.)

Just this year another author's works were criticized in a paper that was written in an insulting and unprofessional manner as a personal attack. (Páll-Gergely, B, A. Hunyadi & K. Auffenberg. 2020. Taxonomic vandalism in Malacology: Comments on Molluscan taxa recently described by N.N. Thach and Colleagues (2014-2019). Folia Malacologica, Poland, 28(1):35-76.) This is reminiscent of Richard Petit's self-published newsletter Conchologia Ingrata wherein for years he defamed and engaged in personal attacks against several authors with whom he held a personal animus. It should go without saying that resorting to name calling and engaging in personal attacks and vendettas is inappropriate. There is no place for that kind of childish behavior in science, and both the reviewers and editors of peer reviewed journals should take a strong stand against that kind of behavior. When an author is unwilling to rework or modify a manuscript to remove insulting language it bespeaks of professional jealousy, ego issues, emotional problems, or long standing personality disputes. A rebuttal paper should be well thought out, supported by facts, communicated in a professional manner, and written with the exclusive intention of improving the field of science. Within the last few years the editors of this journal had to turn down more than one manuscript for publication for precisely these reasons.

There is nothing wrong with people being passionate about their work, or having strongly held scientific positions, however we all need to remember that this is supposed to be about exploring and studying what we see in nature. In the end, one must remember that the act of describing organisms (naming taxa) is merely a way to be able to discuss them intelligently with others around the world.

ISSN 0738-9388

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Shell Diving in the Bays of Victoria, Australia

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If you go to Google Maps and search the bottom south eastern corner of the Australian continent you will find the state of Victoria - at the centre of which are located two large bodies of water, Port Phillip bay to the west, and Westernport Bay to the east. Port Phillip Bay is a vast expanse of water whereas Westernport Bay is home to two large islands and has two entrances; a wide western entrance and a narrow eastern entrance. Around the top of Port Phillip lies the City of Melbourne, a fast growing (before Coronavirus) sprawling metropolis of around 4.5 million people. The shores of Westernport are not as heavily populated, but this bay is subject to strong tides and often turbid water. When not exploring farther afield, these bays are our hunting grounds. Being in the temperate zone, these waters don't support huge numbers of spectacular species as seen further North in the tropics nor do we get to see the magnificent Western Australian endemics (Zoila and volutes); nevertheless this is where we live so we have to make do!

Having met 15 years ago at the Victorian Branch of the Malacological Society of Australasia, we realised we shared the same passion for diving and temperate water shells and so have been diving together regularly for the past 15 years.

Most of our diving is concentrated at the mouth of Port Phillip Bay, an area known as “The Heads”. Here the entrance of the bay is about 1.5 km wide and massive volumes of water pour in and out through The Heads with each change of tide. The bulk of our diving is on the eastern side of The Heads and largely at night.

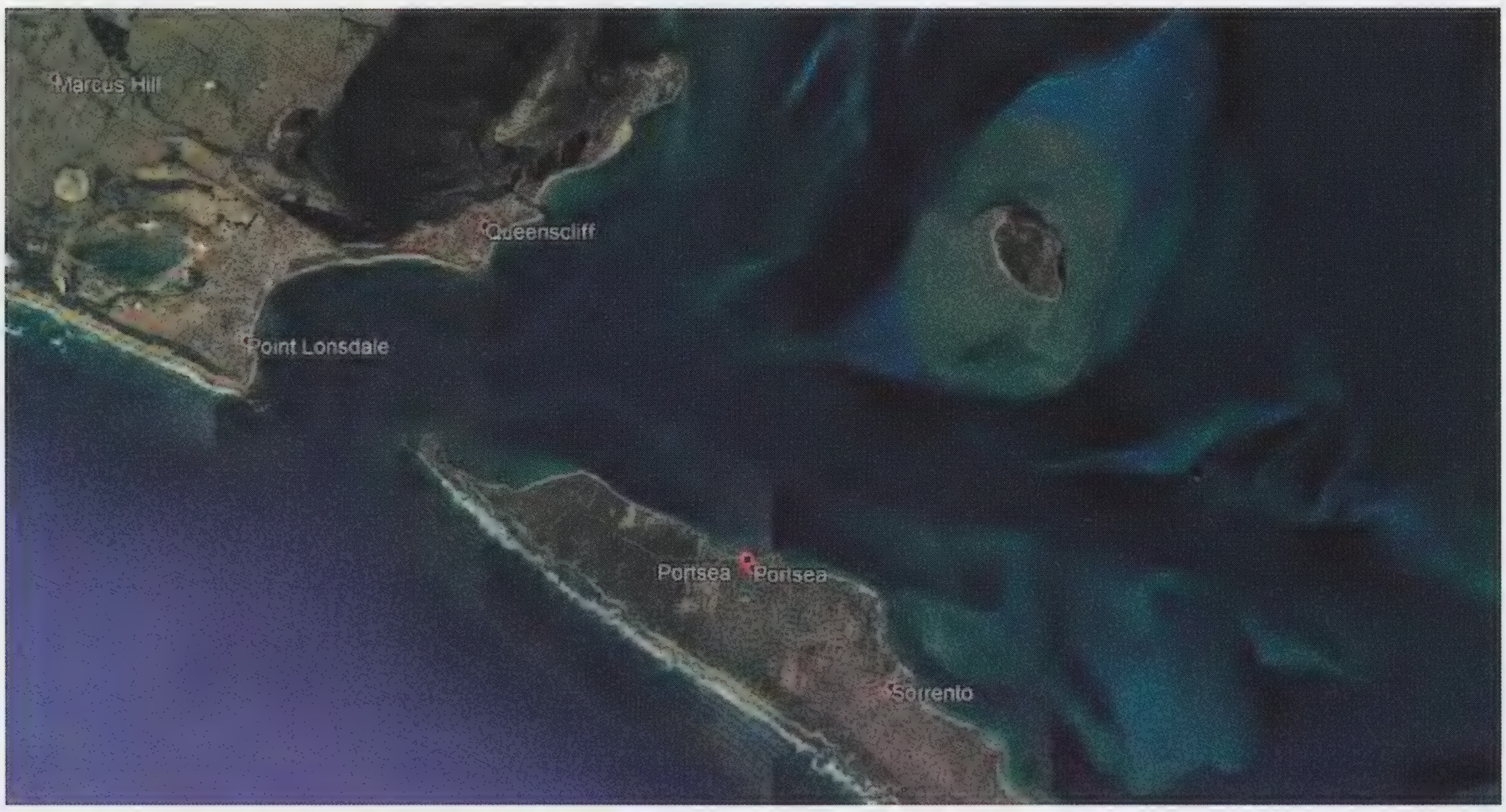

Figure 1. The far Southern entrance “The Heads”, Port Phillip Bay

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The molluscan fauna here is quite diverse and we have recorded in excess of 250 species. Because the area is so close to the open ocean the area is bathed in clean clear ocean water and thus supports a healthy "oceanic" fauna. At the same time, the area is not subjected to large swells and so also supports species usually associated with more enclosed waters.

As mentioned previously, we are not blessed with spectacular exotic species, but we do find that many of the shells we find here are at the extreme large end of their size range. Species such as the triton, *Cabestana spengleri*, and the Pectens *Notochlamys hexactes* and *Semipallium aktinos* are, on average, larger than those found in any other part of their geographic range.

With this article we hope to give some flavour of the diving we do and some of the species we hope to find when we dive. We will describe a typical dive in Port Phillip and a sample of what we experience in Westernport Bay.

Planning for each dive entails a check of the weather, tide charts and confirmation that our respective spouses do not have alternate duties scheduled for us! We dive all year round in water that ranges from 10° Celsius in early Spring to 23° Celsius in early Autumn. In the past, we did not let strong winds prevent us from diving but after a couple of near miss incidents we now only dive when the winds are 15 knots or less.

For this dive we are heading to a location known as Point Franklin. At this site we need to get in the water at the top of the incoming tide to enjoy a fifteen-minute period of slack water and then use the start of the ebb tide to take us to our exit point. Local knowledge proved vital for this site, as we learnt from bitter experience not to dive when the tide is incoming as it generates a strong offshore current that is almost impossible to swim against.

This spot can test one's motivation to dive as it involves a hike along an uneven track, negotiating some stairs and a longish walk through soft sand to the entry point, on the western edge of the point. Here we fill our collection bottles with seawater (so they do not float out of our B.C. pockets!) and do our usual pre-dive checks; check torches work, air is turned on, etc. The best ground is found in 16-18 metres of water on the eastern side of the point so we have to decide if we are going to undertake a strength-sapping surface swim to our designated descent point or walk around the base of a sandstone cliff, through potholed, ankle-snapping reef. If the sea is rough, we usually opt for the swim. We must get around 80-100 metres offshore before descending, which we usually do once we cannot see the bottom when we shine our torches downwards.

If our timing is right, we descend to the top of a sandy slope covered in seagrass, in about 8 metres of water. We then follow this slope down to an area we have termed "the deep rubble ground". There are not many shells to be found on this slope, although the cassid, *Semicassis semigranosum* can be found in sand patches. These shells can be large for the species, often exceeding 55mm. The pecten *Mimachlamys asperrima*, always enclosed in an orange encrusting sponge, is found sporadically amongst this area.

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The deep rubble ground is an exciting place to be. It consists of beds of dead shell interspersed with sand patches and is home to a myriad of sessile life such as sponges, bryozoans and ascidians. Here, attached to the substrate, one can collect the highly prized *Notochlamys hexactes* and the thorny oyster *Spondylus tenellus*. Gastropods include, *Amoria undulata*, *Lyria mitraeformis*, *Pterochelus triformis, Astele subcarinata*, *Notocypraea piperita, Conus anemone* and, extremely rarely, *Typhis yatesi*. Large *Haliotis laevigata* (up to 200mm) can be found on areas of flat sandstone substrate – these are strictly protected in Port Phillip (and it is illegal to take any species of abalone at night) so are a "look but don't touch" species.

Figures 2 & 3. *Lyria mitraeformis* Lamarck, J.B.P.A. de, 1811 crawling on rubble at night, Portsea & Crib Point, Westernport Bay. [Photos – Michael Lyons & Simon Wilson]

Frequently, the siphons of the cockle *Acrosterigma cygnorum* can be seen emerging from the sand, and it is a worthwhile exercise to dig them out of the substrate as sometimes you might "hit the jackpot" and unearth the stunning yellow form. An even rarer find is the spectacular frilled venus, *Bassina disjecta.*

As the top of the tide approaches, any current disappears and the diving becomes a joyous experience, especially if perfectly trimmed, as you can fin slowly, taking in the underwater scenery around you. Before long, however, a slight ebb current can be felt, and this is the signal to start making our way shoreward.

By this time, we are back on the western side of the point and the area consists of sand ridges interspersed with reef covered with brown kelp. Here we encounter shells such as *Turbo gruneri*, *Mitra vincentiana, Hastula brazieri* and *Amalda marginata*. As the ebbing tide increases in strength we are whisked along at a fairly brisk pace and we swim diagonally across the current back to shore, frequently signalling each other with our torches when we spot interesting sea life.

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Figure 4. *Mitra vincentiana* Verco, J.C., 1896 crawling at night. (synonymised with *Turriplicifer australis* (Swainson, 1820) by most authors but clearly differs in shell characters and the animal of *T. australis* is uniform charcoal whereas *vincentiana*'s animal is white with khaki blotches). [Photo – Michael Lyons]

When we are back in 8 metres, we encounter some large underwater caverns that are absolutely coated in marine life, including spectacular yellow gorgonians. Shining our torches into crevices we sometimes find *Semipallium aktinos* and, if lucky, we might find the odd Compton's Cowry, *Notocypraea comptonii*.

Figures 5 & 6. *Alcospira marginata* Lamarck, J.B.P.A. de, 1811 crawling in rubble @17m at night. *Notocypraea comptonii* Gray, J.E., 1847 juvenile specimen with Shrimp guardian at night. [Photos – Simon Wilson]

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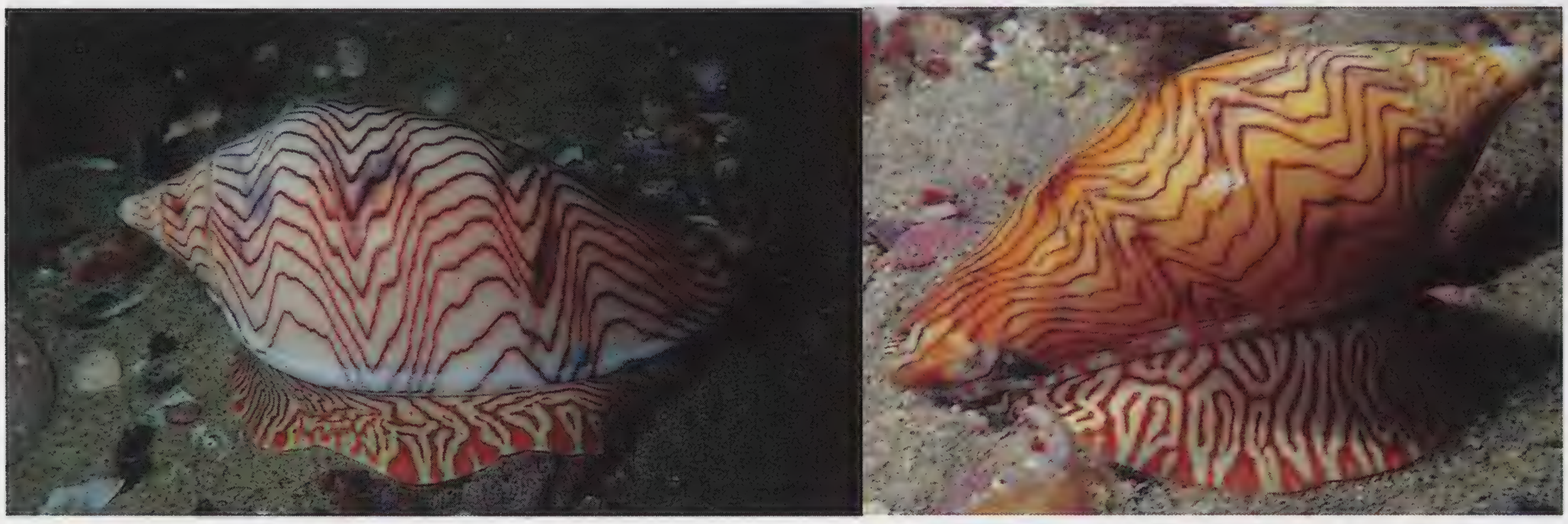
Before long we are in shallow water and the seafloor is covered in wireweed, *Amphibolis antarcticus*, and we begin to be pushed backwards and forwards by the shore break. This is often the most dangerous part of the dive and it is a delicate balance deciding when to remove our dive fins. Often there is a steep, soft sand bank that can be very difficult to negotiate, especially if the waves are big - and there has been more than one occasion when one of us has been knocked off our feet and had to perform a rather ignominious exit, crawling up the bank, being swept in and out with each wave, and ending up with what seems like several kilos of sand through every nook and cranny of our dive gear. Back on dry land we commence the walk back to the car, swapping war stories of what he had seen and/or collected.

We have conducted limited diving on the western side of the Heads mainly around the area known as Queenscliff. This involves a two hour plus drive across the metropolitan area of Melbourne and also transversing through the city of Geelong. The molluscan fauna here is somewhat different, however the finds thus far just do not warrant us diving here on a regular basis.



Figures 7 & 8. *Amoria undulata* Lamarck, J.B.P.A. de, 1804 crawling on sand at night. [Photos – Michael Lyons]

Figure 9. Finds from a good night's diving at Portsea. [Photo – Simon Wilson]

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While typically experiencing underwater visibility of 5 to 15 metres when diving Port Phillip Bay, diving in Westernport Bay is an entirely different proposition. Visibility is usually poor and greater than 5-meter visibility is a plus! This is partly due to the fact that there are large areas of mud and mangroves that are exposed at low tide, if there is any wind this mud gets stirred up and is mobilised into the water column with the high tide, also large differences in tide height during spring tides seem to mobilise a lot of suspended sediment.

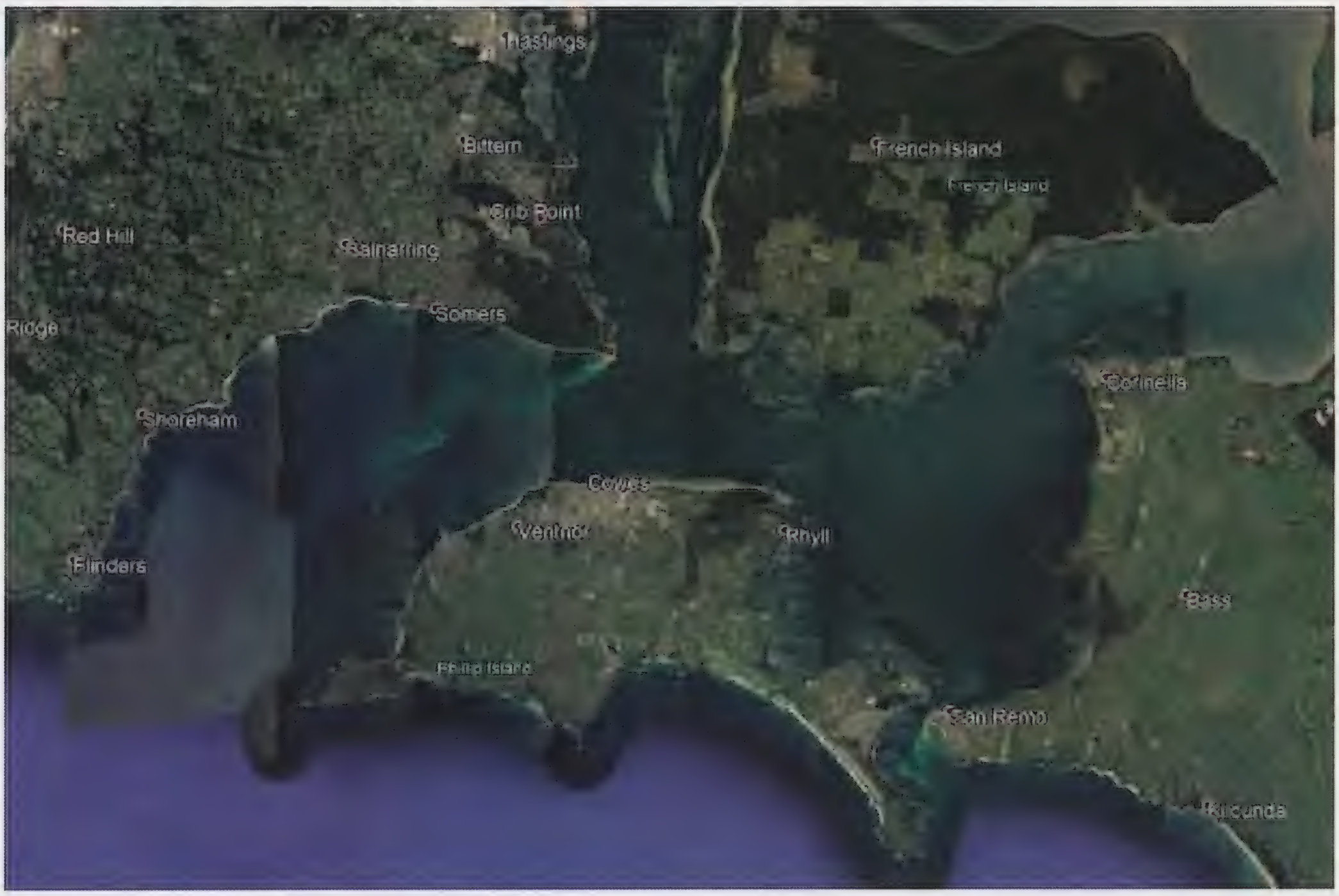

Figure 10. The Southern part of Westernport Bay

When diving Westernport we concentrate our efforts around a particular jetty. Again, tides play a big role in when we can enter the water, although, here we like to enter the water about two-thirds through the flood as the flooding tide brings with it the clearest water.

Because this site is so tidal, the area beneath the jetty and the jetty pylons are absolutely covered in filter feeding marine life. Water temperature range is the same as Port Phillip.

Many species of molluscs found in Port Phillip occur here but there are some significant differences. For example, the distorted triton *Sassia subdistorta* is very common here but not found in Port Phillip and *Conus anemone*, which is common in both bays, is a direct developer, in that there is no veliger stage and young cones are miniature versions of the adult and crawl away when hatched. This results in shells that are quite different between the two bays.

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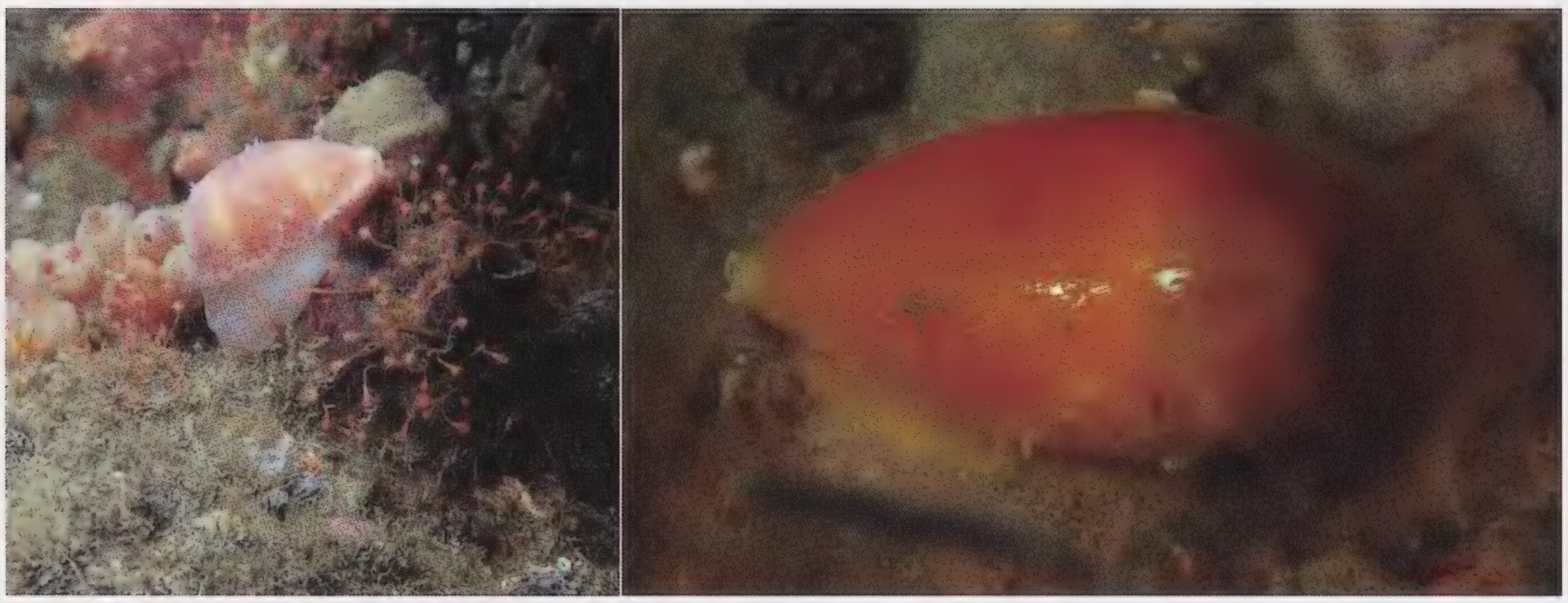
We enter the water at an entry point on the jetty then surface swim with the flooding tide to our descent point then usually follow a jetty pylon down to the bottom in about 9 metres of water. We usually give each other the "OK" signal then go our separate ways, often not seeing each other for the duration of the dive.

The seafloor at this site is particularly silty and if one of us gets upstream of the other the downstream diver experiences zero to half metre visibility! At this site we find up to 4 species of Ranellids, world record sized *Prototyphis angasi*, the magnificent looking "Broach shell", *Neotrigonia margareticea, Notocypraea comptonii* (usually a rich dark chestnut colour versus the golden-orange form from Port Phillip) and *Notocypraea piperita* (if extremely lucky (1 in 50 dives) we might find the stunning uniform cream coloured *wilkinsi* form).



Figures 11 & 12. *Notocypraea piperita* Gray, J.E., 1825 crawling on ascidian & wilkinsi form juvenile crawling on yellow encrusting sponge secreted under a rock slab, both at night. [Photos – Michael Lyons & Simon Wilson]

This dive is always filled with anticipation, as you feel that your next find might be interesting. As the flooding tide abates there is a marked drop in the visibility, often down to less than 0.5 of metre, however, at the end of the slack water period, the start of the ebb tide sees the visibility increase again. We then use the ebb tide to drift us back to the entry landing.

It took a lot of exploration to find our regular dive sites. Interestingly, the best diving in Port Phillip Bay is close to the open ocean, whereas in Westernport the further away from the ocean the better! Early efforts to dive Westernport were largely unsuccessful. We concentrated our efforts on the far south western areas that faced the open ocean at places such as Point Leo, Shoreham, and Flinders. These areas all provided an abundance of dead shells on their beaches.

However, our efforts to dive these areas saw low visibility and frustratingly few live mollusc observations of any interest. The few times we had dived at night were downright spooky. They involved a circa 70 minute drive, a long walk across soft sand, negotiating rocky reef platforms and often significant surface swims before diveable depths were reached.

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Dives a bit further into the bay at Somers and Merricks Beach were largely unpleasant events with low visibility and masses of suspended wireweed leaves (that we refer unflatteringly to as "tea leaves"). These dives proved relatively futile.

It was not until May 2010 that the first author ventured into the waters off Crib Point at night alone. It was an interesting night; the strong ebb current was slowing as I entered but the in water horizontal visibility was only circa 3m. However, I quickly noticed some profuse invertebrate growth in the patchy reef areas in 3-6m. I then started to see quite an array of molluscs including numbers of *Sassia subdistorta, Cabestana spengleri* and *tabulata, Pterochellus triformis*, large *Calliostoma hedleyi* and *armillata*. Under clumps of bryozoan I found a few specimens of *Notocypraea comptonii* which really excited me. These were small but dark brown based specimens. Venturing deeper, I observed colourful red and orange *Conus anemone* and numbers of the endemic volute species *Amoria undulata*. Sadly, most had eroded and sunburnt dorsum's, but the living animal of this species is certainly spectacular.

After around sixty minutes the flood current was starting to become quite strong. I made my way back to shore pleased with my exploratory dive. After letting the second author into my little secret, the general area around Crib Point became a regular dive on our schedule - when the best currents corresponded with darkness and suitable weather conditions. It can however be an unforgiving area if one is not prepared. In the early days, we were caught out a few times returning to shore with our tail well and truly between our legs.

Occasionally we would enter the water with ideal conditions and return to the surface facing a veritable maelstrom making the surface swim back to shore and wetsuit doffing most unpleasant indeed. The weather conditions in Victoria are challenging as they are in many parts of Southern Australia. Winter diving often brings improved clarity but bone chillingly cold water. The strong tidal currents provide a challenge but also bring in the required nutrients for the profuse invertebrate growths that occur in this area.

The species list from this area is now quite extensive and some of our best finds are amongst the most spectacular shells either of us have collected in Southern Australian waters. One has to spend many hours under water to find such treasures, but it is the potential of these finds that keep our interest levels high.

In fairly recent times we have explored the high current waters off San Remo at the Eastern entrance to Westernport Bay. This is indeed a dangerous area to dive and we have completed a few high adrenaline dives. As the tide changes one has to make an immediate dash to shore as tidal currents here can exceed 6-8knots at times in an area known as "The Narrows". Shell finds thus far in this area have been reasonably modest but enough to give us some hope.

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Figures 13 & 14. *Astele subcarinata* Swainson, W.A., 1855 a rare find nestled amongst profuse invertebrate growth at night & *Conus anemone* Lamarck, J.B.P.A. de, 1810. [Photos – Simon Wilson & Michael Lyons]

Figure 15. Selected finds from Southern Port Phillip & Westernport Bays 2005 – 2020. Of note is the 33.5mm specimen of *Notocypraea piperita* from Westernport Bay. Unregistered WRS specimen. [Photo – Simon Wilson]

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To be a Victorian Shell diver one needs to be made of tough stuff and have relatively low expectations. We just do not have the spectacular endemic species of SW Western Australia or even South Australia. The general abundance and quality of molluscs in Victorian waters is lower on average than for the corresponding species in SW Western Australian, South Australian or even Tasmanian waters. Why this is the case is a constant source of frustration to us. Saying that, there are examples of molluscs being at their largest & finest in the waters of Port Phillip and Westernport Bays. Some examples being *Turbo gruneri*, *Semicassis semigranosum*, *Lyria mitraeformis*, *Notocypraea piperita*, *Protyphis angasi*, *Cabestana spengleri*, *Notochlamys hexactes* and *Semipallium aktinos*.

Description of a Topotype Population of *Prunum sunderlandorum* Petuch & Berschauer, 2020

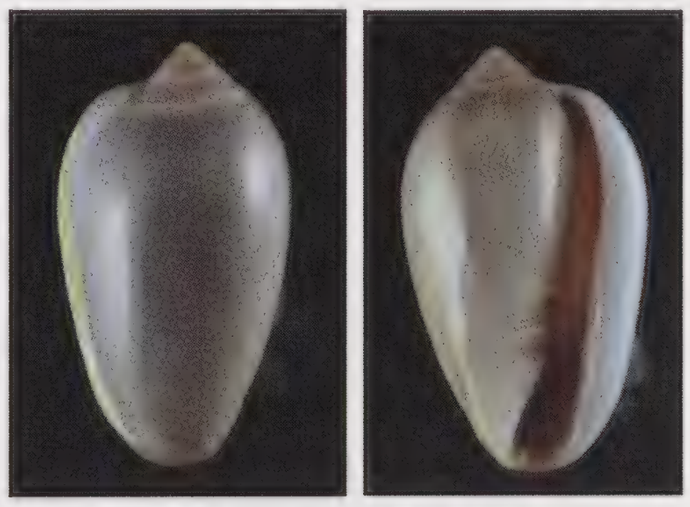
David P. Berschauer

Kevan and Linda Sunderland collected the type lot of *Prunum sunderlandorum* Petuch & Berschauer, 2020, consisting of 28 specimens on a trip to Honduras in 1987. Recognizing that this small Marginellid may be a new species they selected seven specimens from the lot which they collected and provided them to Dr. Edward Petuch for study. One specimen of the seven shells which were examined by the authors was chosen to be the holotype, and is now lodged with the Los Angeles County Museum of Natural History as LACM 3802. The Sunderlands retained 16 specimens from the original lot, which are illustrated herein; the lengths of these specimens are also listed.

Holotype: 12.6 mm in length

Petuch Collection:
11.3 mm and 12.4 mm

Berschauer Collection:
11.7 mm, 11.6 mm,
11.5 mm and 12.3 mm



Holotype LACM 3802

Sunderland Collection retained specimens:

P7	11.8 mm	P15	11.4 mm
P8	11.3 mm	P16	11.5 mm
P9	13.1 mm	P17	11.7 mm
P10	12.0 mm	P18	12.3 mm
P11	12.4 mm	P19	12.0 mm
P12	12.6 mm	P20	12.5 mm
P13	12.3 mm	P21	12.0 mm
P14	12.5 mm	P22	12.6 mm

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E. adansonianus adansonianus (Crosse & Fischer, 1861),Bahamas, 106.1 mm. *B. poppei* (Anseeuw, 2003), Tonga Islands, 58.8 mm. *P. amabilis* f. *maureri* Harasewych & Askew, 1993, USA, 42 mm. *B. tangaroana* (Bouchet & Métivier, 1982), New Zealand, 55.9 mm. *P. quoyanus* (Fischer & Bernardi, 1856), Curaçao, 50.7 mm. *B. philpoppei* Poppe, Anseeuw & Goto, 2006, Philippines, 65.1 mm. *B. charlestonensis* Askew, 1987, Martinique, 77.3 mm. *B. midas* (Bayer, 1965), Bahamas, 82.7 mm.

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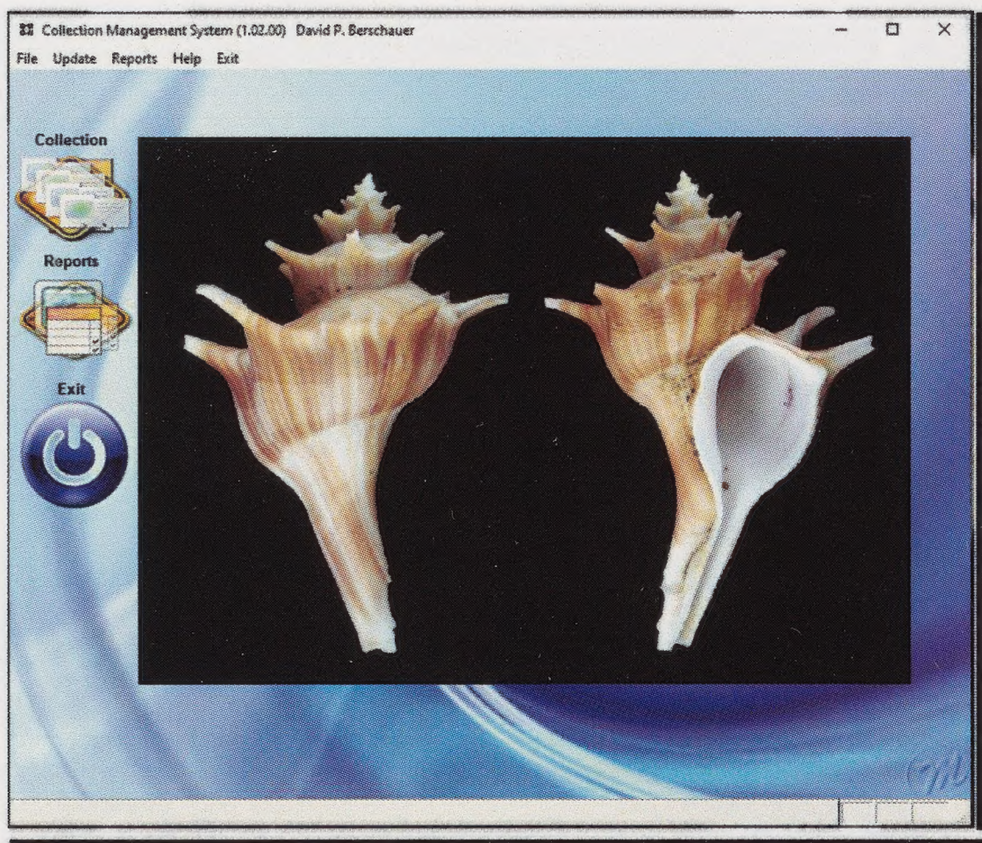

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Back cover: *Cinctura* species collage including: *C. hunteria, C. hunteria apalachee, C. lilium, C. lilium connori, C. tortugana, C. tortugana traciae, C. keatanorum, C. branhamae,* and *C. branhamae morgane* (Cover artistic credit: Rex Stilwill)

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